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FEATURES

R-22 Safety Alert 1

IFR Mountain Flying—It Can Be Iffy, Part 2 2

Preventing Landings Without Clearance 5

Landing Gear Lessons 8

Post-Flight? What's That? 12

What If? 16

Tethered vs Moored Balloons 18

Balloon Landings: How To Use a Drop Line 20

FAA Certificates Three New Aircraft 22

The Renaissance of General Aviation, Part 2 24

DEPARTMENTS

The Old Cap'n, Part 3 17

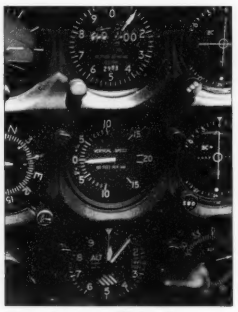
In the HANGAR 21

FlightFORUM 25
InstrumentCORNER 26

AvNEWS/BRIEFS 27

Test You Piloting IQ . . . . . *Inside Back Cover*

On the Cover: *What goes up . . . . See landing articles starting page 5. Photo courtesy of Learjet.*



You do a preflight, but what is a post-flight inspection? See page 12.

Advice to balloonists on how to use a drop line. See page 20.

H. Dean Chamberlain

R-22 Safety Alert

by William Wallace

The FAA has issued a special safety alert to owners and operators of R-22 and R-44 model helicopters, advising them of recent fatal accidents resulting from main rotor/fuselage contact and wire strikes.

Since certification of the R-22 in 1979, there have been 21 fatal accidents resulting from main rotor blade/fuselage contact. Thus far in 1994, there have been five Robinson helicopters destroyed in fatal accidents; three were associated with mast bumping, and two involved flight into electrical wires.

Mast bumping occurred in almost all of those accidents either preceding or immediately following contact of the main rotor blades with the fuselage. Mast bumping may occur with a teetering rotor system when excessive main rotor flapping results from main rotor blade stall, low g maneuvers, abrupt control input, or some combination of these elements.

The NTSB has identified three in-flight break-ups that occurred while the helicopters were being operated at cruise speeds well within the aircraft's defined operating envelope.

In concert with the special airworthiness alert, the FAA has initiated a research program to address the issue of main rotor blade/fuselage contact and mast bumping. At the present time awareness and education are the only means of reducing this type of accident. Until the FAA completes an evaluation of the features that lead to mast bumping, pilots of R-22 and R-44 aircraft are urged to:

- *Limit forward flight airspeed to the minimum possible, commensurate with the airspeeds prescribed in the Rotorcraft Flight Manual (RFM) for safe operation.*

Low g is a significant contributor to excessive rotor flapping and mast bumping. The capability of the helicopter rotor system to general g (positive or negative) is directly proportional to airspeed. As airspeed is reduced, the rotor system is less capable of commanding an inadvertent low g condition and, thus, there is a reduced risk of encountering mast bumping. High airspeed also contributes to retreating blade stall, accentuates the effects of turbulence, and requires increased engine power with the attendant possibility of rotor rpm decay.

H. Dean Chamberlain

- *Restrict flight operations to the lowest possible density altitude commensurate with safe height above the ground.*

As density altitude is increased the main rotor flapping resulting from low g flight is increased. Thus, the margin between the maximum flapping angle and contact between the hub and mast is reduced at higher altitudes. Additionally, power available decreases and power required increases with increasing density altitude. Therefore, the risk of rotor rpm decay is greater at higher altitudes and the ability to recover lost rpm with engine power is reduced at higher altitudes.

- *Use maximum power on rpm at all times, unless in autorotation.*

Rotor rpm decay can result from loss of engine power or pilot inattention, exceeding the performance capability of the helicopter. RPM decay is insidious, and RPM control demands pilot vigilance at all times.

- *Do not fly in turbulence that is forecast or observed to be moderate or severe.*

"Ride quality" in turbulence is a function of several factors, predominantly gross weight. The relatively light gross

Continued on page 7

IFR Mountain Flying—It Can Be Iffy

by Ken Hoffman

Part 2
En Route

In the last issue, we explored planning and departures. I offered some Rules of Thumb (ROT). Here are some more.

ROT #7. Don't run into anything.

It is very important to stay mentally oriented as to where you are relative to your intended route and your surrounding terrain. I like to call this "spatial orientation" or "situational awareness." Some pilots come by this quite naturally. Many of us have to make a special effort, particularly when flying in unknown territory. Some pilots never seem to get oriented.

I recommend filling out a flight log as a part of your flight planning. This helps to create that "picture" of your route. Study the Low Altitude En Route chart and the relevant minimum en route altitudes (MEA). This helps create that all important mental picture. Once you are en route then follow along, not only on your flight log but with your en route chart as well. Don't trust your flight log alone. What if you left out a leg and made a turn one VOR too early and flew into terrain? (As you may have guessed, that has happened.) Even when I have a computer generated flight log, I like to at least mentally create a flight log of my own.

One more thing. Have the VFR chart handy. The VFR chart, normally a WAC or a sectional, is important in case you need to know which way to go downhill in an emergency situation.

In the late '60's, an airplane with five souls on board, including a babe in arms, was flying IFR through southern Colorado. As the pilot flew over high terrain west of Alamosa, CO, the airplane began to pick up ice. The several calls the pilot made to Center went from concern to panic. The call recorded the screams of his family as he lost control of the airplane. A long search ensued, during which I volunteered the use of one of our helicopters and John, our chief flight instructor. When the wreckage was finally located, John verified a suspicion; there were no VFR charts on board.

The point is, if the pilot had been able to determine where he was relative to the terrain, he very likely would have made a 180 and flown downhill toward the wide-open San Luis Valley.

If your only engine quits, you want to head for the valleys where you will find most of the airports and nice, big meadows. [A pilot] did just that not long ago, flying southwest from Denver, CO, in his airplane. The engine quit while he was on the gauges. He broke out over South Park and set it down on a road with nary a scratch.

If you have a twin, you should consider drift-down. With proper planning, flying a twin with a single-engine service ceiling lower than MEA can still be safe, if you allow for drift-down. For many years, Frontier Airlines flew the trusty DC-3 over some of the roughest routes at altitude far above their single engine service ceiling. You can bet that every captain knew where downhill was for every segment of the route.

ROT #8. Know thy mountain wave.

There are three types of clouds associated with the mountain wave: the cap cloud, the rotor cloud, and the lenticular. These are of special concern to the pilot flying IFR in the mountains.

The cap cloud sits on top of the ridge, creating the wave and may extend several thousand feet above. It is formed as a result of moisture-laden air being lifted up the slope and, you guessed it, likely will contain supercooled water droplets that will cause ice to form on your aircraft in large quantities at very fast rates. The Continental Divide west of Denver, CO, has, for many years, been referred to by pilots as the "great ice wall."

While lecturing on mountain flying at a flight instructor revalidation clinic, I mentioned the hazard of ridge icing. During a break, a seasoned-looking pilot approached and expressed gratitude for my emphasizing the subject.

"Ridge icing is very hazardous, but you seldom see it mentioned in the texts," he said.

Sensing a real-life story, I said, "Okay, what is your most serious encounter with ridge icing?"

He said he was flying a Convair 440. Most of the trip from DEN to ASE [Aspen] was in the clouds, terminating with a TACAN approach. It was mostly uneventful. After a 20-minute turnaround, he took off for the return flight. Passing Kremling VOR on the 067 degree radial (V-220) to intercept the 313 degree radial of DEN, they were "foxtrot, delta, and hotel" (fat, dumb, and happy). Suddenly, as they approached the Continental Divide, they started accumulating ice at an alarming rate. They began applying anti-ice heat to the wing. METO (maximum except takeoff) power was applied. When ice brought the airspeed down to minimum acceptable level, altitude was sacrificed. As they were descending through MEA, they were watching the DME very closely. Any lower and they would have to be sure to fly a heading that would take them downhill. They knew that once they saw 37 DME, downhill would be straight ahead toward the prairie, which was preferable than doing a 180 back toward Kremling, CO. As they approached the critical point, the anti-ice was beginning to remove the ice, and the descent rate was minimal. Shortly after seeing the magic number 37 on the DME, "poof," they broke out of the clouds. He said the ice on the unprotected areas of the aircraft had, in fewer than 10 minutes, built to an estimated four inches.

Years before, a pilot flying eastbound in the same area was not so fortunate. When he began losing altitude, he thought he was still west of the divide and made a 180 into rising terrain. His timing may have been thrown off by the significant increase in groundspeed while in the influence of the wave.

The rotor cloud, located downwind from the ridge and at approximately ridge height, is normally visible, rather than imbedded. Its greatest hazard is turbulence. [Other experienced mountain flying pilots] emphasize the wisdom of avoiding this area, especially when flying downwind with high ground speeds.

The lenticular cloud is laminar in flow and normally poses no particular hazard, except the vertical movement of the air can be taxing for autopilots that are trying to hold altitude. The wave action of the mountain wave can extend well over 100 miles downwind from the ridge from which it was formed. In extreme cases, it may be best to ask ATC for a block altitude, take the autopilot off altitude hold, and maintain attitude rather than altitude.

I had an experience where I employed soaring techniques to cross a ridge. I would fly parallel to the ridge when in the lifting part of the wave. Then, when ready to go to the next wave, I would fly perpendicular at a fast speed to minimize the time in the descending portion of the wave. All of the requests for heading and altitude changes, however, are very confusing for the unknowing controller. "You're doing what?"

A seasoned local pilot (SLP) or an aviation safety (formerly accident prevention) counselor can advise of areas to avoid that may be notorious for turbulence or icing. They can also recommend areas that have favorable conditions as well.

ROT #9. Allow for lots of extra time when flying mountain IFR.

This goes in spades for a route that will be into the wind. By the time you maneuver for altitude and terrain avoidance and suffer the slow ground speeds while over the ridges (wind speeds can more than double over ridges), all those calculations you made during flight planning become a joke. On the flight mentioned above, where I was using soaring techniques to negotiate the wave, we were on our way to work a flight training clinic in Seattle, WA. Our ETE for our Piper *Cherokee* 180 to fly the 61 miles from Jeffco Airport (between Denver, CO and Boulder, CO) to Kremling, CO was 37 minutes. ATE was one hour and seven minutes for a whopping 54.6 knots ground speed. Our planned Salt Lake City, UT fuel stop was changed to Grand Junction, CO. It turned out to be a very long day.

ROT #10. Ice is bad stuff.

(Exception: Ice is good in iced tea and other refreshments.)

Ice decreases speed, lift, range, climb performance, service ceiling, visibility through the windshield, radio reception (ice has been known to break off antennas), propeller thrust, and air to the engine for combustion as well as cooling.

Ice increases gross weight, stall speed, fuel consumption, time en route, and heart rate.

A few years ago, a national aviation publication published a series of articles on the hazards of ice encounters. A pilot in Alaska wrote a counter article where he basically pooh-poohed the scary stuff. By the time his article was published, he had iced up a high performance twin and crashed.

ROT #11. When you encounter ice, DO SOMETHING! Climb, descend, or make a 180.

Procrastination is definitely not a virtue in ice encounters. If climbing is an option you may want to pursue, accumulated ice may degrade your performance enough to soon take that

option away from you. Flying V101 between Vernal and Salt Lake City, UT, the MEA is 15,000 feet. If you are flying westbound at 16,000 feet, descending to the MEA may not be much help. Sometimes the best option is a 180-degree turn and get out. Unfortunately, the longer you wait, the less attractive a 180-degree turn becomes, and a pilot will naturally be more reluctant to exercise that option.

There have been times when I have seen a light dusting of rime ice building on the airplane that caused little or no concern. This is indicative of stratiform clouds that are very stable. Then comes turbulence, indicating cumuliform clouds, and clear or mixed rime and clear ice starts to form at a rate that becomes a great concern.

Or, take the situation where the airspeed starts a pattern where it builds, then decreases as the autopilot attempts to hold altitude. This probably is an indication of mountain wave and may be a clue of a ridge ahead. Watch out for ridge icing.

ROT #12. Stay alert.

The endurance of the average airplane well exceeds the attention span of the average pilot. After several hours on autopilot at cruise, complacency can become a problem and a bored pilot can do some dumb things.

I was on my way from Denver, CO to San Diego, CA flying a Beech *Debonair* equipped with a turbocharger, tip tanks, built-in oxygen, and a really neat stereo system. The cap cloud over the ridge west of Denver was too high for us, so we headed south. Passing Pueblo, CO, we were cleared direct to Alamosa, CO. Flying at FL220, we were above the cap cloud lying over the Sangre de Cristo Mountains. I explained to my wife, who is also a pilot, that we were fine at this altitude because we were going to be above the clouds. Just at the wrong time, I decided to select one of the tip tanks. Dumb! Dumb! Dumb!

The engine quit from the air in the fuel line. By the time I got the engine going again, we had descended into the clouds and were picking up ice.

We couldn't hold altitude! I asked the controller where we were in reference to the ridge, and he said, "Say again." I got out the sectional chart and set Terri to work calculating the radial and distance from the Alamosa VOR. Once on the windward side of the ridge, the situation rapidly improved. I elected to land at Alamosa to give proper thanks to the person who looks after me so well. On short final, the ice came off the left wing, which added interest to the very gusty crosswind landing.

To avoid boredom and/or complacency, update weather, play "what if?" games, or review your emergency checklist. But stay alert.

ROT #13. Keep your O_2 up.

In the early 1960's the floor of the positive control airspace was 24,000 feet. I regularly flew a Cessna 180 and a Piper PA–24–250 *Comanche* above 20,000 feet, without oxygen, to get over clouds that had built up over the ridges. Then, I heard a lecture on hypoxia. I immediately installed an O_2 system in the 180 and purchased a portable kit for use in other airplanes. Now I use O_2 above 10,000 feet at night and above 12,500 feet during the day. In addition to being more safe, I just feel better at the end of a trip.

ROT #14. Keep your energy up.

I am a firm believer in taking along plenty of healthy food, snacks, and water on a trip. Our mind and body need energy to perform just as our airplane needs energy to run.

ROT #15. Make that extra stop.

Pilots are often tempted to stretch the fuel too far or to push a bad situation. En route airports will usually have hot coffee, restrooms, nice people, and fuel trucks. In my experience, I have always been happy with the result of a decision to stop en route. Never mind all those boasts about how far or how fast your airplane flies or that your in-laws, who think you're crazy anyway, are waiting at your destination.

ROT #16. A pilot who pushes bad weather is usually buried on a clear day.

Just don't push it. Make smart decisions. Be willing to go twice or three times as far or whatever is necessary to avoid placing your flight in jeopardy.

Flying "missing man" formations over a funeral service can be a special tribute to a pilot who dies of natural causes and a real bummer to do so for a pilot who did something dumb.

As though this hasn't been enough, we plan to conclude this series in the November/December issue by addressing arrival considerations. ■

Mr. Hoffman is the owner of TechniFlite, an advanced pilot training facility located at Centennial Airport in Colorado. He is a 17,000-hour pilot with all the ratings in the world. He says that if you would like to share your story about IFR flying in the mountains, curse his "distortion of facts," or simply have questions, contact him at TechniFlite at (303) 792–9720. Babette André of Wings West *magazine has graciously given us permission to reprint this series, which appeared in the Fall 1993, January/February 1994, and April 1994 issues of* Wings West.

Preventing Landings without Clearance

by Sheryl L. Chappell, *NASA, Director of Research for ASRS*

Landings

A potential breach of safety at controlled airports

A great many reports to NASA's Aviation Safety Reporting System (ASRS) identify pilots' failure to obtain clearance before landing. This reporter's experience is typical:

> *I was the pilot flying on an IFR approach into MEM for runway 36R. My Captain was in communication with Memphis Approach Control. They told him to contact the tower at the Outer Marker. The weather was IMC and when we arrived at the marker, we were in the process of making final landing configurations of our aircraft. The Captain forgot to call the tower, and we landed the aircraft safely and without a conflict with another aircraft on runway 36R.*

Fortunately, most incidents like the above do not result in traffic conflicts or other hazardous consequences. However, their *potential* for a breach of safety is high.

So that we could better assess the factors contributing to landing-without-clearance events, [NASA] analyzed a small number (37) of ASRS reports and identified areas where safety improvements might be possible.

Contributing Factors

Procedural, workload, and memory factors appeared to be the main contributors to the group of ASRS landing-without-clearance incidents.

Pilot not on Tower Frequency

Pilots landing without clearance were often on a frequency other than the tower frequency. Of the 34 pilot reporters who mentioned the frequency they were using when they landed, 25 said they were on approach frequency, while only eight were on tower frequency. Of the eight reporters who *did* change to tower frequency, five made initial contact with the tower but did not receive landing clearance. Nine of the 37 reporters stated they had never received a frequency change.

This finding has important safety implications. If an aircraft is not on tower frequency, the tower will not be able to contact it directly should a go-around or other safety-related action be necessary. Also, pilots who land without changing to tower frequency, as instructed, could be in violation of FAR § 91.129, which requires aircraft operating into airports with an operating control tower to established two-way radio communications with the control tower (unless aircraft are not equipped for two-way communications).

High Workload

Twenty-one reporters implied that their workload was high during approach. The reporters' sources of workload were varied. Some were in a training situation, and some were busy coping with weather conditions, as on this approach:

> *During approach to CLE we were on vectors to intercept ILS 28 at 3,000 feet, which we did. We began to encounter precipitation, freezing rain and snow. We were cleared for the approach and to contact tower. . . . As we approached [the intersection] we were told to keep 170 knots. . . . Our bug speed was 121 knots. Approaching . . . LOM we began to experience light turbulence. Our airspeed dropped 20 knots and gained 30 knots max. The glideslope intercept moved very fast to center of bull's eye with over 1,000-foot descent to stay on glideslope. There was also 20 degrees crab and fluctuation to stay on localizer. This was very distracting to us and to other aircraft on approach. We placed a lot of concentration on maneuvering the aircraft on the glideslope and localizer and failed to change over to tower at the marker. . . . After we touched down we realized we did not switch to tower frequency for landing clearance.*

The large number of incidents citing workload factors suggests that when workload is high, pilots should exercise additional caution to verify that landing clearance has been received. [Checklists help with the workload and help to assure that you don't miss things when the workload is high.—*Editor*]

Forgetting to "Contact the Tower at the Marker"

Another pattern in the 37 reports was the likelihood of pilots' forgetting to contact the tower if they were told to do so in advance. Nine reporters indicated they were told to "contact the tower at the marker," sometimes as far as 20 miles out. Seven of these never switched to tower frequency. In the other two reports it was not stated whether a frequency change occurred. The following example was typical:

> *My First Officer and I were returning from Harlingen, TX to Austin, TX on our 10th and final leg of the day. We logged eight hours that day of flight time in rough weather (thunderstorms, turbulence, and occasional wind shear). Austin Approach Control cleared us for the ILS 31L approach to Austin Mueller Airport while we were approximately 10 miles outside the marker, and instructed us to contact the tower at the OM . . . . After landing and turning off the runway, I noticed that we were still on Approach Control frequency and had forgotten to contact tower at the marker.* [Checklists, again!—*Editor*]

Confusion over Phraseology

Pilots' confusion over phraseology may be an additional factor in their failure to contact the tower. Some pilots may mistakenly believe that the instruction "contact the tower at the marker" means they are supposed to change frequency immediately but not call tower until they reach the marker. This misunderstanding may result in their leaving the approach frequency prematurely and being unavailable for contact if the approach controller needs to issue other instructions. [Not to mention traffic advisories.—*Editor*]

Paragraph 4–33(d) of the *Airman's Information Manual* explains the proper procedures for complying with frequency changes:

"When instructed by ATC to change frequencies, select the new frequency as soon as possible **unless instructed to make the change at a specific time, fix, or altitude** . . . . If you are instructed to make the frequency change at a specific time, fix, or altitude, **monitor the frequency you are on until reaching** the specified time, fix, or altitude unless instructed otherwise by ATC." [ASRS emphasis in bold type.]

Some ATC Considerations

One suggestion for decreasing the number of landings without clearance came through loud and clear in the ASRS reports we received: Pilots suggested that controllers *not* give the change to tower frequency *until they want it to occur.*

These reports were typical:

> • *Landed on runway 26R in ATL without clearance. Cleared visual 20 miles out told to contact tower at marker. It seems this is the only phase of flight in which you are passed to another controller and told to contact them at a different time . . . . If Approach Control wants you to contact tower then it should be at the time of transmission or the flight crew should be told to switch by the approach controller when it is required.*
>
> • *. . . . I feel we were led into a trap by giving us an automatic change over to tower at marker, which reduced approach controller's workload but also increases the pilots', especially in those types of conditions [dark and stormy night].*

Approach controllers we talked to while preparing this article told us they have several reasons for giving the instruction to "contact the tower at the marker." One is to maintain an optimal arrival traffic flow. If the change to tower occurs too early (before the marker or final approach fix), tower controllers may slow incoming traffic or issue other instructions that disrupt the approach facility's arrival spacing, especially in busy terminal areas. Also, if the approach controller delays issuing the frequency change to tower until an aircraft actually reaches the marker, frequency congestion may make it impossible to complete the change to tower in a timely way.

For many controllers, then, the phraseology "contact the tower at the marker" accurately represents the point at which they need for the frequency change to occur.

Techniques for Prevention

[NASA's] analysis of ASRS incidents led us to the conclusion that the best safeguard against landing without a clearance is to develop procedures to [en]sure that a frequency change has taken place and landing clearance has been received. As these reports show, it is not advisable during a busy approach for pilots to rely on memory to determine whether they have been cleared to land. [Checklists, yet again.—*Editor*]

Create a Visual Reminder—and Check it

Some pilots have developed an effective technique of performing a **positive action** that creates a **visual reminder** that is **checked** as part of their landing procedure. All three of these elements reduce the likelihood of landing without a clearance. For example, some pilots leave one of the taxi lights off until landing clearance is received. They put the light on when the clearance is received, giving them a visual reminder—the switch position. They then visually check that the light is on as part of the landing checklist. [Why not add "Landing Clearance—Received" to the checklist?—*Editor*] A shortcut could be the time-honored GUMP check with an addition—**GUMP-C: GUMP-C** stands for **G**as, **U**ndercarriage, **M**ixture, **P**rop, **C**learance to land.

Another technique is to combine a **visual reminder** with an **audible confirmation** of tower frequency. When the landing checklist calls for "cleared to land," the pilot not flying (PNF) visually checks the communications radio to ensure that the correct tower frequency has been set, then [says], "Cleared to land (specific tower frequency)."

In order for any reminder to work, that final check has to be performed. [These incidents are] from several reporters who learned this the hard way:

> *Since the incident I have adopted the technique of mentioning "cleared to land" on final gear and altitude callout.*

I flew the ILS to 26L and all checklists were completed normally. At 500 feet I called '30 flaps, final setting (normal procedure), cleared to land?' The first office and second officer verified 30 degrees flaps and said nothing more. I thought I had heard a clearance to land so did not question the first officer again. I landed . . . . Approached Control answered and we realized that the first officer had not switched to the tower at the OM . . . . Switching to the tower at the marker is so routine it never dawned on me that the first officer may not have done it . . . . In the future I will say, 'Are we cleared to land?' instead of merely saying 'cleared to land?' Since the incident the company has added a 'cleared to land' check on the 1,000-foot callout.

Change to Tower at a Fixed Point

Another way for pilots to stack the deck in their favor is to develop a habit of always checking that they are on tower frequency at a fixed point, such as at the Outer Marker or when completing the landing checklist. A fixed altitude may also be the landing clearance reminder, as this reporter notes: *"In the future I will check at 1,000 foot AGL that we are on tower frequency."* If a pilot reaches this predetermined, fixed point and has not yet been instructed to change to the tower frequency, a request to Approach Control to change frequency is recommended.

Even pilots who routinely use this technique can forget to change frequency if they allow distraction or complacency to interfere:

I always go to tower and call at the Final Approach Fix, but was still doing checklists and then became too preoccupied with the approach. Missed part of approach habit pattern. [Maybe not if that habit had been in black and white on the checklist.—*Editor*]

Conclusion

There are no foolproof techniques we know of to prevent landings without clearance. But fewer of these events are likely to occur if pilots adopt techniques that will help them remember during busy approaches to "tune in" to the tower and verify that they have received landing clearance. ■

Ms. Chappell is the NASA Director of Research for the ASRS and a member of the Air Traffic Procedures Advisory Committee, a government-industry group that works to improve air traffic safety. This article originally appeared in the February 1994 issue of CALLBACK, *a monthly safety bulletin from NASA and based on ASRS reports. For further information about ASRS, contact the Office of the NASA Aviation Safety Reporting System, P. O. Box 189, Moffet Field, CA 94035–0189.*

H. Dean Chamberlain

R-22 Safey Alert

Continued from page 1

weight of R-22 makes it (and other aircraft in its weight class) more susceptible to the effects of turbulence. Most notably, main rotor flapping and aircraft attitude are effected by turbulence and can lead to blade stall, abrupt control inputs in response to uncommanded attitude deviations and ultimately, mast bumping.

- *Maintain balanced flight at all times.*

Sideslip creates lateral flapping in excess of that encountered during normal flight. This excess flapping allows less margin for lateral cyclic maneuvering in response to a low g induced roll.

- *Do not fly below 500 feet AGL except during takeoff and landing.*

The frequency of wire strikes in the R-22 and R-44 is alarming and can only be eliminated by maintaining a safe height above the wires. Pilots do not intentionally fly into wires, but wire strike accidents result from flying at altitudes lower than necessary and from the lack of awareness of the presence of wires.

- *When hovering out of ground effect, always hover into the wind.*

Hovering out-of-ground effect often requires engine power close to the manifold pressure limit. A crosswind or tailwind increases the power required to compensate for the extra tail rotor thrust that may be required. Couple this power demand with pilot attention concentrated outside of the helicopter, and a unrecoverable loss of rotor rpm can result rapidly with the disastrous effects of rotor stall and main rotor blade/fuselage contact. ■

Mr. Wallace is the FAA's National Resource Specialist for Rotorcraft Operations. If you require additional information, contact him at (202) 267–3771

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G.S Livack

Landing Gear Lessons

by John W. Conrad

Landings

A little knowledge of how your gear works can prevent a short-field landing in a shower of sparks

Odd as it may seem, the most common major accident to occur at airports results from pilots landing airplanes with the wheels retracted. Aircraft manufacturers have tried horns, bells, whistles, lights, sirens, and mechanical indicators to alert pilots to the situation, but airplanes continue to slide down the runway on flaps and curled prop tips.

A large percentage of the gear-up accidents are a direct result of the pilots' failure to put the landing gear handle in the "down" position and to check for a gear-down indication before landing. This often happens in training situations, when pilots become overwhelmed and overlook this one important item. It also occurs often when pilots forget to retract the landing gear on takeoff and move the switch to the "up" position on downwind, thinking that they have put it down.

In such cases a change in procedure causes the pilot to forget the landing gear. The pilot who completes the written checklist feels he or she has done the proper thing to ensure the safety of the aircraft. But if the pilot has accidentally skipped the landing gear check, the pilot may feel warm and fuzzy, but the wheels are still up.

To avoid this possibility the pilot needs to develop a simple procedure that can be followed regardless of other distractions. The procedure is simply this: Every time you cross the runway threshold, approach lights, or boundary fence, check to see that you have a gear-down indication. Whether crosswind or no wind, short field or long, IFR or VFR, with one engine running or two engines running or no engines running, check for gear down *every time*.

For about 10 years, I flew nothing except retractable-gear aircraft. Then, when I checked out in a Cessna 182, I was positively neurotic because there were no green lights glowing at me on final. Intellectually, I knew the landing gear was down and welded, but I was uncomfortable without something to check when I was supposed to check it.

Beyond situations in which pilots simply forget to throw the switch or put the handle in the wrong position, there are lots of mechanical problems which can result in a gear-up landing that could otherwise be avoided. A thorough understanding of how your landing gear system works and why it works can help you avoid a short-field landing in a shower of sparks.

Motors and Gears

Probably the most common design uses an electric motor and a gear-box to crank the landing gear up and down. Some older twins and many other singles and light twins use these devices. The advantage is that they are relatively simple and usually do not require up-locks to keep the landing gear retracted in flight. The disadvantage is the complex mechanical linkages required to make them work.

The electric motor itself does not create enough power to raise or lower the gear. The system depends on the mechanical advantage achieved through the gearbox and the various levers in the system. It is possible for this system to develop several hundred pounds of mechanical advantage at some points, so in essence what you have is a very powerful mechanical device grinding away in the bowels of the aircraft.

All of the parts, including landing gear doors and extension devices, are attached to one another mechanically. So, if something goes wrong or is bent, the entire system can literally grind to a halt. One stray screw left over from the annual inspection can become lodged and bring the entire program to a halt. Furthermore, because of the power in the system, a small malfunction can result in considerable damage before the circuit breaker blows.

There are two types of emergency extension mechanisms associated with this type of system. One is a mechanical crank which simply does what the electric motor would have otherwise done. Obviously, if the system is

G.S Livack

jammed, you are not going to be able to turn the crank either. A less common method releases the electric motor and gear drive mechanism and allows the landing gear to free-fall into position. If something jams, you might have to become a mechanic to fix it.

In some aircraft the entire landing gear retraction and timing mechanism is under the two front seats. The crank for emergency extension sticks out behind the seats. Should the motor fail, the pilot should slow down, pull the circuit breakers, extend the crank, and then do the work of the electric motor. But if the linkage jams, the crank is not going to work any better than the motor did. One pilot removed the front seats, opened up the area where the landing gear mechanism was, and removed a Swiss Army knife that had somehow found its way into the works. He then reassembled the airplane and landed. [Rather than making this a standard operating procedure, make sure your aircraft interior and landing gear wells are free of objects that could work their way into linkages and jam them. See "Keeping the Flight Controls Free and Correct" in the May/June 1991 issue.—*Editor*]

Though few of us have the mechanical expertise to perform this bit of improvisation, a thorough understanding of the landing gear mechanics can help in an emergency. During an annual inspection, try to get a look at the workings of the landing gear so that you know what moves what and why. Ask the mechanic to perform a gear retraction (when the airplane is jacked up, of course) while the inspection plates are removed so that you can see how it works. Someday you may need to know.

Motors and Pumps

Another common system for landing gear actuation uses an electric motor to run a hydraulic pump. The pressure from this pump is then routed through pipes and hoses to hydraulic rams which are connected to the landing gear legs.

This system also has its advantages and disadvantages. One of the big advantages is that the landing gear are not mechanically connected, so one jammed component cannot jam the whole system. Though there is dubious advantage to landing with one main landing gear retracted as opposed to landing with both retracted, if you can get the nose gear down, you can usually save the engine and propeller.

The disadvantage is complexity. There are really two separate systems, an electrical and a hydraulic. A problem with either affects both. Electric systems, of course, are dependent upon the aircraft battery and alternator. Hydraulic systems are dependent upon the correct operation of the pump and a series of valves, switches, and, in some cases, mechanical up-locks. There must also be an abundance of hydraulic fluid in the system and an absence of air, which can act as a shock absorber and make it difficult for the landing gear to lock in the down position. Air also can get into the pump and cause it to quit functioning altogether.

For backup many electro-hydraulic systems provide a hand pump to generate hydraulic pressure. But like the crank which serves as a substitute for the motor, a hand pump which is used in the event of an electric pump failure will have no effect on a problem that is deeper in the system, such as a lack of fluid or an abundance of air in the system.

Most of these systems are also equipped with a free-fall mechanism which either releases hydraulic pressure or opens the up-locks so that the landing gear can drop into place. It is essential that the aircraft be at the correct airspeed before the system is released. Otherwise, the landing gear could be caught in transit by the wind load on the wheels or landing gear doors.

It is also important to remember that most electro-hydraulic systems do not use up-locks but rely on hydraulic pressure to keep the landing gear retracted. If the pump fails, the landing gear will slowly extend.

Engine-Driven

Some aircraft have an engine-driven hydraulic pump instead of an electrically driven one. This eliminates one opportunity for failure in that, other than the indicator lights, the system is completely independent of the electrical system. Of course, if the engine is not turning, the hydraulic pump will not work either. A few single-engine general aviation airplanes use this type of system, but most piston-engine warbirds have it. It is more commonly found in twins. If the engine bearing the hydraulic pump malfunctions, the pilot's workload increases.

Indicators

Most modern aircraft use a series of lights to indicate the landing gear position and an electric horn to warn the pilot of an impending gear-up landing. These electrical devices can present the pilot with as many difficulties as mechanical retraction linkages.

Normally, there is a system of microswitches which are all too often stuck out on the landing gear legs

where they can easily be damaged. For the green light to illuminate on the instrument panel, one or more switches need to be in exactly the right position. Here again, a few minutes spent exploring the system with a mechanic can eliminate a lot of tension on final when only two of the three lights are glowing.

Many aircraft are also equipped with a "gear in transit" light. On some aircraft, the absence of a gear in transit light is an "all clear," even if one of the green lights malfunctions. On other aircraft it is not. Likewise, the absence of a gear warning horn may mean that the landing gear is in the correct position or that the landing gear *handle* is in the correct position. You have to take the time to learn how your particular system is wired in order to make the correct decisions.

Of course, if you are in the habit of carrying power through the round-out, you might as well throw the gear warning horn out the window. The horn usually will not blow until the throttles are closed, which may be too late.

Believe it or not pilots disconnect some mechanical indicators. For example, the Ryan Navion was originally equipped with little gear-up indicators which popped up through the top of the wing. Most of them have been removed because they cost a quarter of a knot in airspeed. (It makes you wonder what people are thinking about.)

Mechanical difficulties abound in landing gear system, but the most common problem is still pilot error. Lest I sound holier than thou, let me tell you about how I ended up short final last year with the landing gear retracted. I was flying a Beech *Baron* into Mexico. As I approached Tepic, Nayarit after six hours of flying, I was tired, and the weather was lousy. I barely had a 1,000-foot ceiling, and I had to go through a pass to get into the valley where the airport was. I was watching for towers and powerlines, and there was another airplane reported inbound. I was on final when the controller (to whom I will be eternally grateful) advised to check my landing gear. Would I have caught the gear-up situation when I crossed the threshold and checked for the lights? I do not know. Would I have heard the landing gear warning horn as I closed the throttles, even though I was wearing heavy headphones? I do not know that either. All I know is that it can happen to anyone, given the right circumstances.

Handling an Abnormal Gear Situation

The first time you put the landing gear handle in the "down" position and only two of the three lights come on, it feels like someone just socked you in the stomach. The smell of adrenaline permeates your nose, and the flight-or-fight reflex kicks in with a vengeance. Unfortunately, there is no one to fight and nowhere to go. You are stuck in the left front seat, and it will be up to you to fix the problem.

Usually, you do not discover a landing gear problem until you are close to the airport. In VFR conditions, it is common practice to lower the landing gear on downwind. If everything is not exactly right, the pilot should immediately add power, raise the landing gear, and depart the traffic pattern before trying to fix the problem. There is little point in fooling with the landing gear and having a midair collision in the process.

Many pilots do not lower the landing gear in IFR conditions until the aircraft passes the final approach fix or intercepts the glide slope. If there is a problem here, the pilot should begin a missed approach procedure immediately and get up to altitude before trying to fix the problem. In IFR I prefer to lower the landing gear in most light singles and twins a long way from the airport. This allows me to get my speed under control, keep the engines nice and warm, and also learn about a problem early on.

After taking an airplane with a landing gear problem back up to altitude, slow down to well below landing gear speed, and try to extend the landing gear again. If you get three green light, *do not retract the landing gear again*. Leave the gear down, return to the airport, land, and have a mechanic take a look at the problem.

If one green light is not lit, the obvious problem is that the light bulb is burned out. Switch bulbs with one that is working or, better yet, use the "gear in transit" light—if it lights, all is well.

If the problem is more serious, your knowledge of the system comes into play. You need to know if the absence of a landing gear horn indicates that all three gears are down. Slowly close the throttle and see if the horn blows. If all is quiet, and if the horn is coupled to all three landing gear down-locks, then all three are down and locked. On some aircraft the gear horn is coupled to one side of the nose wheel up-lock switch. The absence of a gear warning horn only indicates that the handle is in the "down" position and that the nose wheel is not up and locked. The main

gear can be nicely stowed away, and all will be silent. You have to know your system.

Let us say there is a more serious problem. If you are familiar with the emergency extension procedure (and you should be), perform it slowly, precisely, and carefully. If you are unfamiliar or in doubt, read the procedure before trying it. Your best shot for having it work may be your first shot.

If the emergency procedure fails, you may be able to help the situation by "loading and unloading" the airplane. (I think I would try to unload it first, in the hope that I could jar something loose.) To "unload" pull the airplane into a climb and (with everybody advised and securely buckled in) push forward until things start floating in the cabin. [Remember, of course, to remain within the airplane's operating limitations.—*Editor*] The landing gear will be floating, too, and this may be all it takes to free a stuck part.

If unloading fails, try loading the airplane up to two or three G's, but not to exceed its design limitations. Keep the airspeed slow—certainly below V_{le} or V_a—and you will get an accelerated stall before you hurt anything.

If this does not solve the problem, it is time to get some help. Slow the airplane to best economy cruise speed, and lean the engine to peak EGT. This gives you some time and additional range to fix the problem or get to an airport at which you eventually want to land. Get on the radio and see if you can find some expert help. There have been lots of situations where creative solutions from mechanics on the ground have resulted in finally getting the landing gear lowered.

Ultimately, if you are forced to land with one or more landing gear retracted, go slowly, carefully, and realize that a belly landing is of minimal threat to life and limb. Base your decisions—such as to whether to lower the flaps, whether to land with the gear partially extended, or whether to stop the engine—on your skill and experience, not on the potential expense. That is why you have insurance.

Remember, most people who land gear-up walk away from it, and they do not do it intentionally. If they can do it well accidentally, you should be able to pull it off without hurting anyone.

In summary, to avoid one of the most common aircraft accidents, the pilot needs to develop a habit of always checking for a gear-down indication when crossing the threshold. The pilot of a complex aircraft should take the time to learn all the intimate details of the complex systems. If you have not seen your landing gear system opened up during an annual inspection, you have been remiss. Of course, a careful and thorough preflight inspection is essential to the continued safe operation of the landing gear system. If ever you make a hard landing or a crosswind landing with a substantial side load, have the landing gear examined before you retract them again.

Good procedure, knowledge, and healthy skepticism will keep you out of trouble. ■

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Answers to NDT Quiz

(Located on the inside back cover)

1. **True.** Liquid penetrant NDT inspection is effective on hard and relatively nonporous materials.
2. **True,** but this does not exclude the use of liquid penetrant NDT inspections on magnetic materials.
3. **True.** To obtain reliable penetrant indications, great care must be taken to assure that the parts are clean and dry.
4. **False.** Type I, fluorescent dye penetrant, should not be used over Type II, visual dye penetrant. Indications and detection of flaws depends upon the flow of the penetrant into what may be only a microscopic crack. In some instances a defect may be filled with visual dye penetrant, which would prevent the fluorescent penetrant from entering a discontinuity.
5. **True.** The developer should be allowed to remain on the part approximately one-half the penetrant dwell time but not less than five minutes before inspecting. Excessively long development time can also cause over-development or excessive spread out of the penetrant. Development times are usually limited to one hour maximum.
6. **True.** The standard practice is outlined in MIL-STD-6866 for liquid penetrant. Black lights (for fluorescent dye penetrant method) shall be checked daily (penetrant system manufacturer's recommendation is 90 days), and after bulb replacement, for output. A longer period may be used if a plan justifying this extension is prepared by the NDT facility and approved by the contracting agency. The black light should be checked with a calibrated light meter and must produce a minimum of 800 micro watts/cm^2 measured at a distance of at least 15 inches.

   It is also important to note that the viewing areas for visible dye penetrant method, Type II, (white light) shall be checked weekly to assure a minimum of 100 foot-candles white light intensity at the working level; e.g., bench or table-top and wheel wells.

   Some aircraft/engine/propeller manufacturer's specifically state that liquid penetrant inspections must follow MIL-STD-6866. The recommendations of the penetrant system manufacturer should be followed.
7. **True.** The inspector should be capable of seeing a pink indication on a light background (for visible dye) and yellow-green on a dark background (for fluorescent dye).
8. **False.** Discontinuities observed using the fluorescent dye penetrant method will be yellow-green on a dark background (viewed with a black light).
9. **False.** Fluorescent dye penetrant inspection results should be observed in subdued light using a black light.
10. **True.** Residual acid, particularly chromic acid etch, will drastically reduce the fluorescence of the penetrant. Particular care should be exercised when using this form of cleaning. All parts should be thoroughly washed and neutralized and dried before applying penetrant.
11. **True.** Etch cleaning could be used to prevent this problem; however, NDT inspection instructions prepared by the aircraft/engine/propeller manufacturer must be followed.
12. **C.** 13. **B.** 14. **A, B, C,** and **D**
15. **B.** The viewing area for portable fluorescent dye inspection shall use dark canvas or other methods to reduce the white light background to the lowest possible level. Personnel shall be dark adapted for a minimum of one minute before inspecting.

G.S Livack

Post-Flight? What's That?

by Clint Lowe

Landings

Spending a few moments after a flight can save precious hours the next time you fly

Ah, it's time to go back to reality. It's been a weekend with the in-laws. So far, you've had two political arguments, another on automotive work, and then there'd been the poorly timed comments about your in-law's hair. You're ready to bug out.

As an in-law makes rude comments about you to your spouse, you open the cabin door and discover the master switch in the "on" position. Your heart sinks, since you know you'll be hearing something about your competence as a pilot. A short, post-flight inspection could have prevented this.

There are three advantage to conducting a post-flight inspection. It provides (1) an orderly manner in which to properly secure the aircraft, (2) an opportunity to discover things that are most obvious immediately after flight, and (3) considerably more time to get discrepancies fixed before your next flight.

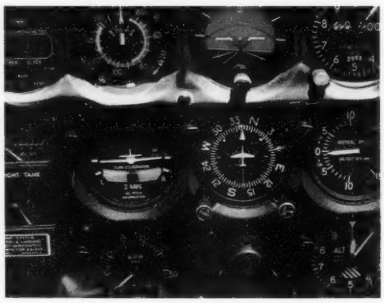
The post-flight inspection begins just before pulling the mixture control to idle/cut-off. This is the "quiet" time during aircraft operation when you can take a moment to monitor your engine and prepare to secure the aircraft. Here are a few things to check (remember to consult your aircraft manual, too):

Radios and Electrical Equipment

If you had an unusually hard landing (due to high winds, for instance), a quick check should be made on 121.5 to see if you set off the ELT. [Good idea after every flight.—*Editor*]

Then, unless otherwise specified, shut down radios and electrical equipment before stopping the engine. Electrical spikes from the dying alternator or generator have been know to zap sensitive electrical equipment.

If you have an avionics master switch, it, too, should be turned off before shutdown.



Engine Operation

Remove your headset and listen to the idling engine for roughness and any unusual noises. Check your oil pressure and other gauge indications to ensure they're within limits. Especially with straight-weight oils, if your oil pressure is nudging the lower limit, you may be operating in temperatures requiring a different weight. Or, you may have a potential problem. If your oil is proper for the temperature, but your pressure is not, consult a mechanic.

G.S Livack

Pre-Shutdown

One engine manufacturer, Lycoming, recommends that after satisfying yourself that the engine is running properly at idle, follow this sequence for shutdown to minimize lead-fouling problems with your engine:

1. Operate the engine for one minute at 1,200 rpm. You may have accomplished this while taxiing into the chocks and during the engine-monitoring procedures described above.
2. Increase to 1,800 rpm for 15–20 seconds.
3. Reduce to 1,200 rpm and shut down the engine with the mixture control.

[For other than Lycoming engines, follow the manufacturer's prescribed procedures found in the aircraft flight manual or pilot operating handbook.—*Editor*]

Ignition Test

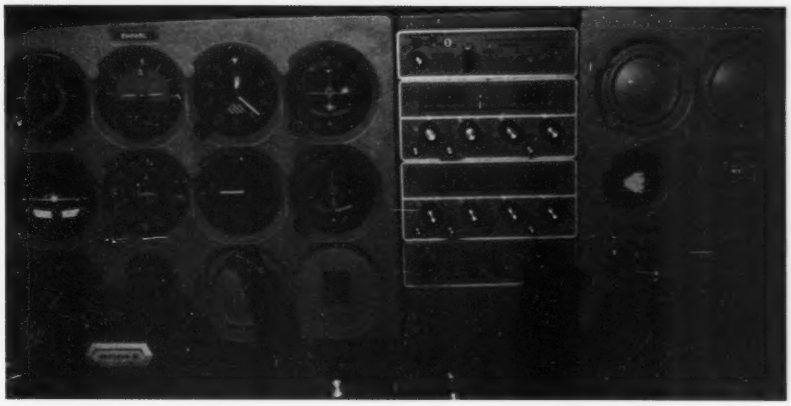
Occasionally (say, every 10 to 15 hours), a check (hot mag check) should be made of your ignition switch by momentarily shutting down the engine with it.

Instead of pulling the mixture on shutdown, reduce the throttle to idle, switch the ignition slowly from "both" through each magneto ("left" and "right") and then to "off." You should get a noticeable drop in rpm at each mag stop and a dying engine at "off." Before the engine quits, place the switch back to "both" and complete the recommended engine shut-down procedures.

G.S Livack

This procedure will enable you to determine if a P-lead has become disconnected or if your ignition switch isn't properly grounding out the mags. If the engine doesn't die when the switch is "off," you have a dangerous condition that requires attention.

After the engine has stopped running, shut off the master switch. This allows the battery to absorb the spikes of the alternator or generator, rather than forcing them into unknown paths in the electrical system.



In the Cockpit

As the instruments spin down, listen to them for excessive noise or grinding. Anything unusual may be foretelling a failure.

After clearing the cockpit, a quick check of the switches should again be made to ensure that no one inadvertently moved one while leaving the airplane. Now would be a good time install a control lock, if you have one.

On the Outside

While tying down the aircraft or waiting for hangar space, a few things can be checked before putting the airplane to bed:

1. Make an overall inspection of areas on the skin for evidence of leakage, especially at places concealing fuel and/or oil lines. These areas include those near the brake lines, fuel lines and tanks, retraction mechanisms, cowling, and belly of the airplane. If leakage is evident, the fresh trail can aid a discovery of the cause.
2. After giving it time to settle, check the oil.
3. Take a flashlight and glance over everything visible under the cowl and note any discrepancies.
4. Take a look up the exhaust pipes and note stack color. They should be light gray or tan. Look for evidence of oil in the exhaust. [Be careful not to touch, since exhaust pipes stay hot for quite a while.—*Editor*]
5. While down there, check the gear for normal oleo extension and the tires for good inflation.
6. Get the plane refueled, if possible. The jury is out on whether topping it off is the best route. Expansion of the fuel in the tanks can send some overboard through the vent and cause an expensive (and environmentally incorrect) puddle to form under the aircraft. Typically, I leave a one- to two-inch air gap below the cap

Phillips 66

The post-flight isn't intended to be a redundant pre-flight inspection. Though you can make it as thorough as you like, it takes only a couple of minutes to accomplish the extra points listed here.

Those extra minutes may mean the difference between a successful early morning departure and standing around in the early hours, suffering slings and arrows from an in-law while waiting for the airport mechanic to show up. ■

Clint Lowe is an A&P mechanic and works on light plane engines and military jet engines. He also owns and flies a Cessna 172. This article originally appeared in the March 1, 1994 issue of Aviation Safety. *For information on* Aviation Safety *contact Editorial Offices, P.O. Box 3970, Frederick, MD 21705–3970; (301) 698–0575.*

PART THREE

The Old Cap'n

by Richard D. Hague

It was the time of year when you think about taking to the air to look at changing leaves, but here I was once again looking at incident reports. Maybe, I thought, I can just get through a couple of these without . . .

"Trying to hide from me, Sonny?"

"Uh, of course not, Cap'n, I just . . . "

"Here, let me see that." The Cap'n snatched up an incident report from my desk.

Aircraft made a forced off-airport landing following fuel exhaustion.

"Holy smokes! This guy is to flying what Don Knotts is to body building. How'd this birdbrain even get to the airdrome let alone off it? What was he planning for? A mid-air refueling? ''Tweren't my fault, yer honor. The gas hose was too short.' Makes me pine for the good ole days of public flogging.

"Fuel planning and management may be even more important to your preflight than route and altitude selection. You can change your track and altitude, but you sure as heck won't find the line person at 9,500 feet!"

"Well, Cap'n," I said, knowing full well what was coming, "what can we do about it?"

"I was getting to that, Dunderhead, before you interrupted me. R-E-S-P-E-C-T, Sonny.

"Now, where was I? Oh yeah. Blow the dust off the Weight and Balance Section of your POH and compute your legal fuel load. Are you to the top? To the tabs? Remember, 'cause you'll need that information later. Now, use that on-board *usable* fuel to compute your endurance. Notice I said ENDURANCE; not RANGE. Big difference. Endurance is TIME; not DISTANCE. And since your fuel gauge is that gizmo strapped to your wrist, plan your fuel according to the *time,* not the *miles*, from Point A to Point B.

"If you're going to make a short trip—meaning something between a long taxi and 90% of your endurance—gas to what you can safely and legally tote. If you're going to make a trip that is one minute longer than 90% of your endurance, plan on a pit stop halfway. Your passengers'll appreciate it. 'Specially the more mature ones like me for reasons that are none of your darn business."

The Cap'n looked off into the distance, as if he were addressing an audience only he could see. Come to think of it, I'm sure only he could see it.

"Starting now, I want you to start *managing,* not just *burning* fuel. And don't get huffy with me. No one ever intentionally runs out of fuel. And besides, if fuel management is good enough for the airlines, it's good enough for you. So, all you so-called aviators out there, here's an Old Cap'n Fuel Checklist for you:

1. **Check the Weight and Balance section of the POH before gassing up your machine.**
2. During your preflight, get into the Performance Charts in your POH and **compute your planned fuel burn off for taxi and takeoff, climb, cruise and descent.** Do it every time until you develop a sense of the numbers.
3. **Keep a fuel log that shows planned and actual burn-off.** Do your numbers consistently show that you're burning more fuel than you plan? Revisit your leaning procedures, the age of your machine, the condition of your engine.
4. **Get an idea of the percentage of actual deviation from the POH** until you are able to predict with 99% accuracy exactly how much time you have left in your tanks at any point in your flight. Save your fuel logs and note the long-term trends. Your A&P will appreciate the information.
5. You'll complete your fuel management process when you **compare your actual burn to what you stuck in the tanks** (to the top? to the tabs?) **earlier**.

The Captain turned to stare at me. "Is that it?" I said.

"Nope! One last thought. Running out of fuel is indefensible. Period."

"Okay, Cap'n, it was good to see you, and . . ."

"Hold yer afterburners, Bucko. What's this one here?" He pointed to another

report I was trying to hide. I handed it over.

"Let's see," he said, squinting at the page.

Pilot landed gear-up. He applied Go-Around power, but the damaged prop set up such an extreme vibration that the pilot chopped the power, lowered the gear, held the aircraft off until the gear extended, and landed. During the post-accident investigation, he reported that he had confirmed the wheels down and locked at the abeam position and again on final approach. He couldn't explain the bent propeller or the scuff marks on the gear doors and fuselage.

"Speak up, Sonny, I can't hear you," the Cap'n shouted, jarring me from my seat. "That gear warning horn is making too much racket!

"They put wheels on airplanes, Dumbo, so's you can taxi at 1000 rpm instead of max power, so's it's easier for you to keep the belly of the airplane cleaner, so's you don't have to do an engine tear-down after each landing, replace the prop every time you start, or put it on jacks when you want to sample the fuel, you turkey! If your social life isn't as full as you'd like it to be, keep on ignoring the checklist. You'll be making some new acquaintances at the FSDO."

"But, Cap'n, it could have been unintentional," I said.

"Now I'm not going to waste your time or mine talking about inadvertent gear-up landings. In terms of gold-plated stupid, it's right up there with running out of petrol. The subject here is integrity, the most important quality that you can bring into the cockpit of an airplane. The quality that, without which, you are doomed to failure as a pilot and as a member of society."

"Integrity?" I queried.

"Whatsamatter, too much time without your ear plugs? Integrity. Probity. Principle. Trustworthiness. The self-esteem that allows one to publicly confess to the world, 'I don't know. I *used* to know. I'm *supposed* to know. I know where it's written down. But right now, even though I'd *like* to know, I don't know. And I could sure use some help.'"

"Well, Cap'n, some people are just ignorant, right?"

"Ignorance is not a shortcoming, Sonny. But stupidity, arrogance, a belief that the laws of physics are negotiable are, in fact, fatal flaws. Show me a pilot who can admit to ignorance, and I'll show you a pilot that'll never make the Six O'clock News. Show me a pilot who acknowledges that he or she will never know all that there is to know about aviation, but who keeps on learning, and I'll show you a pilot that I can trust to do the right thing, a pilot that will err on the conservative side, and a pilot that is educable."

"And the other?"

"I'm getting there, I'm getting there. Not as fast as I used to be you know—and you will know one day, Wonderboy. The pilot who lies to mask his . . ."

"Or her," I corrected.

". . . deficiencies demonstrates that while in command of an aircraft, he's not in command of his character. That he trusts the expertise and self-discipline of the aeronautical engineers who built the machine, he's not possessed of the expertise and self-discipline to operate it. In aviation, flamboyance, indifference, dishonesty, and a pubescent disdain for the property and well-being of others marks one as, not a pilot possessed of judgement and maturity, but a cowardly, skulking graffiti tagger who, with garish brush, contemptuously and indiscriminately stains those of us that would ennoble the process."

Whew, I thought.

"In other words, even with all the shoe polish in the world, you can't put a spit shine on a mud pie!"

I sat there, my eyes tearing at his inspiring words. I took out my handkerchief, dabbed them dry, and looked up to thank the Old Cap'n. I was alone.

That split second of doubt touched me again; then, I glanced down at my incident report. Scrawled in the margin in a spidery hand were the familiar words:

"Keep the blue side up, Kiddo. See you next time!" ■

What If?

by Thomas N. Jones, *Safety Program Manager*

Statistics clearly show the accident rate among general aviation pilots—and especially involving flights classified as "personal/pleasure"—are much higher than any other category. Why does this occur? I believe there are several reasons.

Training

Training (or the lack of) plays a large part in the overall accident prevention picture. If a pilot is trained well, he or she is less likely to be involved in an accident. Pilots who fly for pleasure and for personal transportation are far less likely to have received advanced training. More than likely, the only training they have ever received was the 35 or 40 hours required to obtain a private pilot certificate. After that, the only time recurrent training occurs (in many cases) is during the required flight review.

In some cases, the training received was not under the best circumstances. Not all flight instructors are gifted teachers, and not all have the dedication necessary to ensure their students are the best they can be. Most CFI's are dedicated and do a really great job, but some do not pass on a lot of information. For some obtaining a pilot certificate—the piece of paper—is the only goal of flight training.

Equipment

Equipment is another problem. Our aircraft are getting older. New, more modern aircraft are prohibitively expensive, if obtainable at all. The companies that manufactured the training aircraft in the past are no longer building the relatively inexpensive trainers of a few years ago.

Maintaining the equipment we have is becoming more difficult largely because of the scarcity of reliable replacement parts. Many manufacturers build approved (built to specified standards) and non-approved parts. Differences in parts built by the non-approved sources often are not readily discernible to the unaided eye. In many cases it takes an expert to tell the real part from the "bogus" part.

Replacement parts are not available because either the manufacturer no longer exists or because some parts are no longer being produced. In many cases a part may have to be specially manufactured to keep an aircraft flying. If a part has to be manufactured, exact specifications must be followed in order for the part and subsequently the aircraft to meet airworthiness standards. In any case, you must be sure the parts used to repair your aircraft meet proper standards.

A Solution?

We have these problems, so how do we improve the statistics and continue to reduce the accident rate? There has to be a way. I believe there are several things we pilots—who are limited in the amount of money we can spend for training and equipment—can do.

The simplest and least expensive way to get started in a training program is to be involved in the Pilot Proficiency Award Program—Wings. Aviation Safety (formerly Accident Prevention) Program seminars are free, and they are usually held at night or on weekends. The seminars pertain to airman knowledge and proficiency. Fuel management, airspace, maintenance concerns, and pilot-controller communications are just a few of the many informative and timely subjects offered.

Many states offer weekend programs dedicated to the Pilot Proficiency Program, better known as "Wings." During these weekends people knowledgeable on aviation safety and education topics conduct seminars. The flight instruction provided for these weekends is usually free at these events. What better way is there to increase your knowledge of aviation and your proficiency? Wings programs are free, informative, and entertaining.

Another way to help reduce the accident rate is to read more about how to fly airplanes. A word of warning—steer away from the publications that encourage radical ideas. The FAA, you may be surprised to know, has several books that are excellent training and refresher manuals. For example, the *Pilot's Handbook of Aeronautical Knowledge* (AC 61–23B), is an excellent resource. It is inexpensive and includes a lot of basic information. [This publication is in limited supply and may

only be available through commercial sources. It is scheduled for updating and a rewrite this year.—*Editor*]

The *Airman's Information Manual* is a relevant source of information. An annual subscription is less than a night out at the movies for two.

Take a few minutes and study an aeronautical chart. Are there any symbols you are not familiar with? If so, check the legend, or contact a knowledgeable flight instructor to learn what the symbols stand for. You might be surprised at what you'll learn.

Last of all, pilots can prepare for the "what if's," as professional pilots do before every flight. Airline and corporate pilots prepare a "TOLD" card. This stands for "Takeoff and Landing Data." In that way the pilots know exactly how much runway is required, what the weight and balance of the aircraft is, what speeds will be required for rotation, etc. They routinely plan for the correct action to take if a problem occurs.

All professional pilots plan their fuel loads to arrive at their destination with adequate fuel reserves. They plan for such things as unscheduled traffic delays and headwinds in excess of forecast winds. Of course, for large aircraft there has to be precise planning because of weight restrictions. They cannot have too much fuel or too little. It takes planning for "what if's."

What if the winds are stronger than forecast? Planning a precautionary landing for fuel is infinitely preferable to landing in a field because of fuel starvation. Off-airport landings occur every day somewhere in this country. To do so successfully takes planning.

A good way to complete a flight safely is to comply with FAR § 91.103 (Preflight action). This is the regulation that covers preflight planning requirements. If we were to comply with it 100% of the time, our chances of being involved in an accident would be drastically reduced.

I do not suffer from the delusion that all aircraft accidents can be prevented. I do know that many of the ones we are having could be prevented by paying attention to the "what if's" and by being involved in the Pilot Proficiency Award Program. ■

Mr. Jones is the Safety Program Manager for the Winston-Salem, NC, FSDO. You can subscribe to the Airman's Information Manual, *for $58.00 for a two-year basic and supplement service. The Superintendent of Documents no longer re-issues the entire AIM every 112 days. New subscribers receive a copy of the entire document which is used for two years. Subscribers will then receive supplements or changes at regularly scheduled intervals. Mail your subscription request and payment to Superintendent of Documents, P. O. Box 371954, Pittsburgh, PA 15250–7954; or fax a request (with a credit card number for payment) to (202) 512–2233. The Order Processing Code is *5412. For information on the Pilot Proficiency Award Program, contact your Safety Program Manager at your local FSDO.*

FAR § 91.103
Preflight Action

Each pilot in command shall, before beginning a flight, become familiar with all available information concerning that flight. This information must include—

(a) For a flight under IFR or a flight not in the vicinity of an airport, weather reports and forecasts, fuel requirements, alternatives available if the planned flight cannot be completed, and any known traffic delays of which the pilot in command has been advised by ATC;

(b) For any flight, runway lengths at airports of intended use, and the following takeoff and landing distance information:

(1) For civil aircraft for which an approved airplane or Rotorcraft Flight Manual containing takeoff and landing distance data is required, the takeoff and landing distance data contained therein; and

(2) for civil aircraft other than those specified in paragraph (b) (1) of this section, other reliable infor- mation appropriate to the aircraft, relating to aircraft performance under expected values of airport elevation and runway slope, aircraft gross weight, and wind and temperature.

H. Dean Chamberlain

Tethered vs. Moored Balloons

by Joseph C. White

Ballooning

More than cordage is involved in the distinction

What is in a name? Words are meaningful descriptions—usually. Consider the term "tethered balloon" as distinguished from "moored balloon." What exactly is the difference, or is there any?

Webster speaks of a tether as a restraint placed upon an animal or other living creature, whereas a mooring line is what holds a vessel or similar object firmly in place. This is apparently not of much help toward understanding the pertinent FAA regulations, as evidenced by the misunderstandings and occasional misadventures which have occurred with improperly restrained balloons.

For example, in Georgia, a hot air balloon was used during a ceremony dedicating a pavilion to a well-known balloonist and public-spirited citizen. The balloon's airworthiness certificate had expired, so instead of being free flown it was tethered to a truck and towed over the crowd while two men in the gondola sprayed the onlookers with champagne. Suddenly the balloon began to rise, and the two occupants realized that the tether had broken. Eventually a descent was initiated and one of the men, who had taken some student pilot training, threw out a drag line to slow down the movement over the ground. The lines caught in some trees with an abrupt arresting force that snapped the support cables and allowed the gondola to plummet 200 feet to the earth. Both men suffered serious injuries.

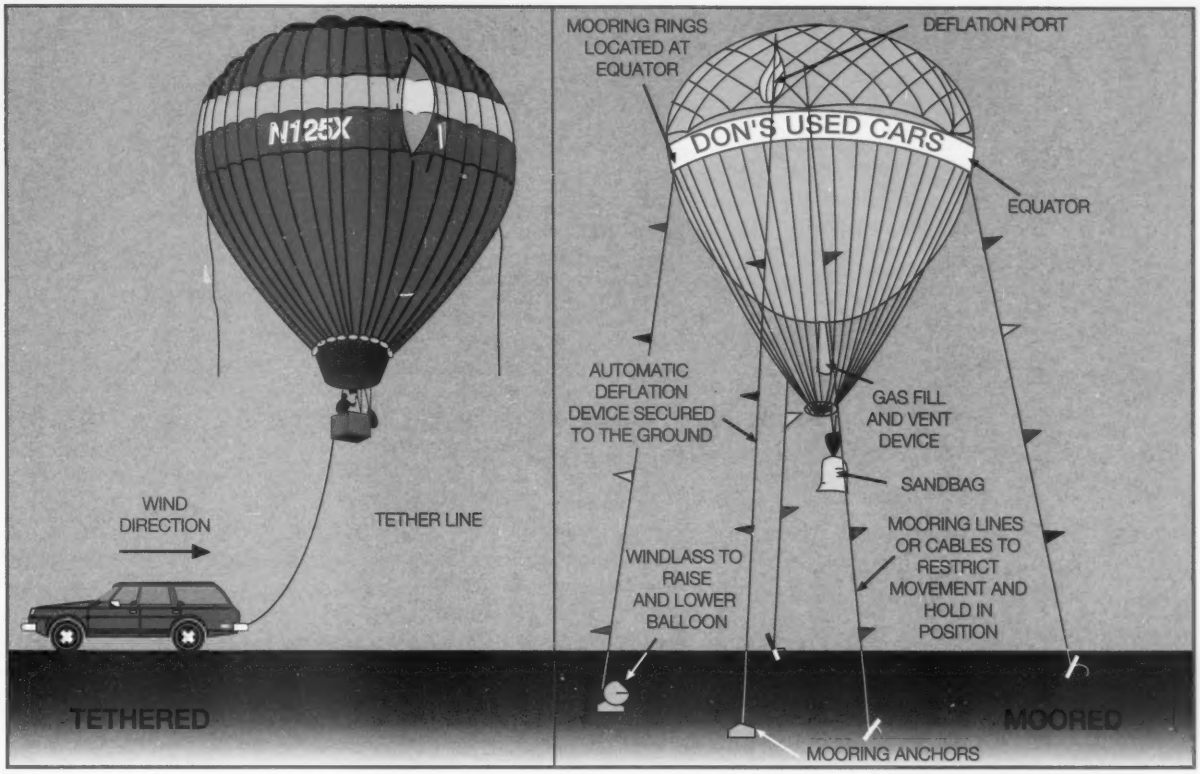
The National Transportation Safety Board investigation listed as a probable cause, "unqualified person operated the balloon." However, from FAA's point of view the entire operation was illegal and hazardous from start to finish, because the balloon was in a nonairworthy condition and should not have been flown, much less by an uncertificated crew. Would it have been less illegal if this balloon had been securely "moored" while the champagne spraying took place? Not necessarily; a balloon that is a registered aircraft should normally not be moored, because the design standards are for the loads imposed for maneuvering in free flight, rather than a moored operation.

FAA regards any balloon which is designed for carrying persons as an aircraft, and as such it must be certificated and operated in accordance with the applicable rules for aircraft. Such a passenger carrying balloon is considered tethered when it is inflated and held to the ground, in whatever manner. A moored balloon (for which there are no prescribed airworthiness standards because passenger carrying was not intended) is essentially any lighter-than-air object operated under FAR Part 101. Such a balloon must be restrained with mooring lines to hold it stationary in the intended location, and the balloon must comply with the provisions of FAR Part 101.

To be operated as an aircraft, a tethered balloon must be registered with FAA. It must also be constructed, certificated, maintained, and operated in accordance with various FAR (Parts 43, 61, and 91). Only a certificated and properly rated pilot may operate such aircraft, and said pilot must always be on board when passengers are carried—even when on a tether. If the passengers are carried for pay, the pilot must have a commercial certificate. The pilot is responsible at all times for the safety of persons on board, as well as for the safety of other aircraft and persons on the ground below.

Incidentally, flight experience may be logged in a tethered balloon, by a pilot or student, for the actual time that the movements of the balloon are not fully influenced by the tether—i.e., when the pilot is controlling ascent, descent, and neutral buoyancy by means of hot air input, venting, off-weighting, etc.

Any balloon not designated to carry people is not regarded by FAA as an aircraft and is regulated under FAR Part 101 only insofar as it might become a hazard or obstruction to flight. It must be more than six feet in diameter or have a gas capacity of more than 115 cubic feet, must be flown no higher than 500 feet above the ground and no less than 500 feet below the base of any cloud, must be flown no closer than



five miles from the boundary of any airport, and must not be flown when the visibility is less than three miles. When operated between sunrise and sunset the balloon and its mooring lines must have colored pennants or streamers attached at 50 foot intervals beginning at 150 feet AGL and visible for at least one mile. When operated between sunset and sunrise the balloon and its mooring lines must be lighted to give a visual warning regardless of its altitude. To prevent runaway accidents, an automatic rapid deflation device must be attached so that it will activate if the mooring lines fail. This device must function independently from any crew or other human input.

The accompanying illustrations and tabular comparisons should help prevent future misunderstandings about restrained balloon operations. If you still have any doubts, consult your local FAA Flight Standards District Office before setting out your lines.

You might have a bear by the tail. ■

Mr. White is a specialist in the Air Traffic Rules Branch in FAA Headquarters.

COMPARATIVE BALLOON REGULATIONS

	Tethered (FAR Parts 43, 61, & 91)	Moored (FAR Part 101)
Occupants	Passenger may be carried with a qualified pilot on board and in control.	Passenger carrying is not intended.
Certification	Must have airworthiness certificate and be FAA registered. Pilot must have FAA certificate.	No certification required.
Lift agent	Usually hot air but may be any lighter-than-air gas.	Usually gas.
Vertical control	Usually hot air burners but may use weights, valving, etc.	Windlass or manual adjustment of ropes.
How held in place	One or more ropes or cables attached to any weighted object or fastened to ground anchors.	Restraining cables deployed in such a fashion as to restrict horizontal movement nearly to zero.
Protection against inadvertent release	Pilot responsibility.	Automatic rapid deflation device.
Size	Not specified.	Diameter more than six feet or gas capacity more than 115 cubic feet.
Altitude flown	As per FAR § 91.119; as per FAR § 91.209 for lights.	Not above 500 feet AGL. If above 150 feet AGL must be marked by pennants, streamers, or lights every 50 feet, as per FAR § 101.17.
Weather minimums	As per FAR § 91.155.	At least 500 feet from cloud base, with three miles visibility.
Near airport	Must comply with applicable sections of FAR Part 91. Good operating practices would require contact with ATC at tower-controlled airports.	Not allowed within five miles, except under the provisions of a waiver issued by the Administrator.
Responsible person	Pilot	Operator

THE PAPER AND INK USED IN THE ORIGINAL PUBLICATION MAY AFFECT THE QUALITY OF THE MICROFORM EDITION.

Balloons: Landings

H. Dean Chamberlain

by Brian Beazly and Bill Bird

Part 2: How to Use a Drop Line

One very useful piece of equipment in your basket is the drop line. If you don't have one, get one. You may not use it very often, depending on the terrain and conditions where you normally fly, but when you need it is not the time to swear that next time you won't get caught without it.

There are several ideas to be considered when using a drop line. A drop line is to be used to guide the balloon to a favorable landing site or to change the flight direction of the balloon away from trees, crops, and other hazards when the wind is light. The major reason we carry a drop line is to help us if we become becalmed over something we can't land in or on, such as small ponds, trees, crops, even buildings, etc. A drop line is *not* for tethering, and it is not an inflation tie-off, and it is not normal to use it in high wind conditions.

Your crew should know as much about its use as you do. Drop line procedures should be practiced occasionally, especially whenever you add a new crewmember. If the crew doesn't know how to handle a drop line, all the good intentions in the world won't help you. The ground person doesn't have to be built like a male or female body building champ to get a balloon to go where you want it. If you work smarter and not harder, any adult-size person can move a balloon around where you want it in light winds conditions (0–5 mph). The most important thing to remember is that the pilot and crew must cooperate and work together as a team.

Most inexperienced crew people grab on and pull as hard as they can, either downward while under the balloon or in a direction against the flight path. Some will immediately wrap it around some object or their body to "stop" the balloon. This can cause the balloon to descend before the pilot is ready, who then immediately overreacts and puts more heat in the balloon to maintain altitude. This only makes it harder for the crew to hold on as the heat takes effect. As they exert more force, the pilot adds more heat, and the tug of war is on—the balloon usually wins!

There are many horror stories of crew persons losing their balance, getting the drop line wrapped around some body part, and then being carried aloft as the pilot tries to regain altitudinal control of the craft.

The problem is that both the pilot and crew did something wrong here. The crew person put too much pull on the balloon, causing it to descend. The pilot, having not instructed the crew, overreacted and added too much heat to overcome the altitude loss. Instead the pilot should add only enough heat to reach equilibrium and let the balloon stabilize. By instructing the crew not to exert any more downward force, altitudinal control is regained. The crew person should hold the line as if he or she were a post—don't pull it and wait until the balloon comes to a stop. The balloon will slow to a stop when it reaches the end of the line. Then the crew person will be able to establish and maintain a better balanced position. Then it is simply a matter of directing and helping the balloon to a landing site.

It is also possible to change the direction of the balloon's flight path to the right or left for the distance of the drop line. To do this, you have the crew person take the drop line at a 90° angle to the direction of the balloon's flight and stand still. The balloon will pivot around to a new position directly downwind of the stationary crew person. There is no need to pull on the line, just stand firmly in place and let the wind and the balloon's momentum do the work. The pilot needs to understand that when the crew person holds the line in this manner, very little lift will be lost. The balloon may momentarily descend, but if the pilot keeps the balloon at equilibrium temperature, it will stabilize on its own.

Your drop line should be attached to the balloon by a quick-release device of some kind. This is in case the line gets attached to something undesirable. Hazards such as trees, fences, powerlines, etc., get in your way when you least expect it. Or, maybe some-

one drags you in the wrong direction or falls down and gets wrapped up in the line. Anyhow, you want to be able to release it rapidly. Some people recommend carrying a knife for this purpose, but most of us may not have the knife readily available, and if we do it poses a severe dangers of its own. A quick release is always ready. Some people will use the inflation harness shackle as the point to connect the drop line quick release. No matter where you have it attached, be consistent so you know where it is immediately and you don't have to look for it.

Many commercial ride operators use drop lines when flying in very tight and limited landing areas. They also recommend the carrying of two drop lines, each equipped with a quick release, so that if they have to "cut" one loose, they still have one available. They also tend to use a rope for their drop line rather than the strap style and they use a stuff bag that is designed with a narrow mouth to allow the rope to deploy without tangles. The bag and rope are faster and easier to stuff and store after landing than the strap style that requires meticulous attention to the roll-up and storage.

No matter which style drop line is used, the pilot and crew need to coordinate its use and practice proper techniques. If you use it only once, all the preparation and practice will have been worth the effort. ■

In an upcoming issue—landing flight paths through low level shears. This series is courtesy of Balloon Life *magazine.*

A Fuel-less Tale

I was a relatively new instrument pilot (one year) coming back to Renton, WA, from Michigan. I left Michigan about sundown and stopped at Sioux Falls, SD, for fuel. As was my usual practice, I stayed and watched the lineman fuel my plane after asking him to top off both tanks. Afterwards I went in and checked weather to Great Falls, MT, my next destination. I felt familiar with the route as I had flown it VFR a couple of time before.

Things were fairly uneventful until about half way to Miles City I noticed that my fuel gauges were reading considerably less than expected. I began calculating my fuel burn more accurately. Since it seemed normal I wasn't too excited at that point. I was tempted to land and refuel at Miles City, with the beautiful moonlight and airport below. After recalculating my fuel and the fact that it was now well past their closing time, I decided to continue on to my original destination.

By Lewistown (156 miles), I really wanted to be on the ground as I had encountered significantly stronger head winds than forecast. However, Lewistown was last reported at minimums and by this time the local folk had long since tucked into bed. With Great Falls a mere 78 miles, I continued on, though realizing I was very close to being in real trouble. Some light icing began to form on my wings so I climbed another 2,000 feet, where the winds were even more significant.

I was given the 11 DME arc for runway 3. When directly south of the airport, my engine stopped. I knew it was fuel starvation, and since I had already run the other tank dry, there was no use switching fuel tanks. I told approach I was going down. It was totally dark out; I could see nothing outside the airplane. Approach gave me a heading, which I tried to maintain, as well as setting up a glide speed.

Eventually, my face went into the instrument panel and everything was quiet. I checked my passenger, who was alive though unconscious. I got out to assess our status. We had taken out a power line and fallen to the ground from there, which fortunately was downslope. Both doors were off as well as the windscreen gone. I started to try to walk to the lights which I could now see, but soon realized walking out was hopeless. I returned to the plane and cuddled next to my passenger for warmth in the back seat, where I had previously placed him to get him out of the below freezing breeze. Four hours later we were found by a line crew six miles from the airport. We both survived, though my passenger was hospitalized for a week.

Looking back, there were several things that could have prevented the accident. First was the fueling. Though I watched the lineman fuel the plane, I did not climb up to check that he had topped it off as requested. As it turned out, he had filled to the bottom of the filler neck on each side, which gave me 30 gallons of fuel less than I thought I had. Second, flying over Miles City, I could have followed my impulse to land. Third, at Lewistown if I had throttled back for best fuel economy and admitted my predicament to Center, I still could have made it to Malstrom Air Force Base. The embarrassment of admitting my fuel status would have been minor in comparison to our injuries and to losing my beautiful bird, which had recently received a new engine and paint scheme. I fully expected to die when my engine quit; however, I knew that my only chance to live was to continue to fly the airplane.

From the Seattle FSDO's Aviation Safety Program newsletter, Aerosafe.

FAA Certificates Three New Aircraft

by H. Dean Chamberlain, *Associate Editor*

In a joint Transport Canada (TC), Federal Aviation Administration (FAA), and Experimental Aircraft Association (EAA) ceremony at the 1994 EAA Annual Fly-In and Convention at Oshkosh, WI, the FAA presented U.S. type certificates to the developers of three new aircraft—the U.S. Quicksilver GT-500 and the Canadian Zenith CH 2000 and Diamond DA 20 Katana.

The July 31 ceremony, hosted by EAA President Tom Poberezny, was held in front of the FAA Safety Center with the newly certificated aircraft in the background.

Paul Fiduccia, President of the Small Aircraft Manufacturers Association, spoke during the ceremony on the future of general aviation and the role the new aircraft will play in the revitalization of general aviation.

Paul Poberezny, Founder and Chairman of the Board of EAA spoke of the role EAA played in the development of the Primary Aircraft Category under which the GT 500 was certificated. He told of his visits to airports across the country in the late 1980's where he noticed a lack of small general aviation aircraft at the airports. He then described his meetings with Tony Broderick in Washington about the need for a new category of simple, sport and recreational type aircraft that would be affordable for the average pilot. The discussions eventually led to the new certification category for light general aviation aircraft.

In his remarks, FAA Administrator Hinson commented about the efforts of Tim Smyth and Greg Michalik from the Chicago ACO for their efforts in getting the three aircraft certificated. He then recognized the hard work and professionalism of Transport Canada and Derek Ferguson and his certification team for their efforts by saying, "Canada has been our partner in aviation for a very long time. I mean where aviation is concerned there is really no border. We want to thank Canada and Transport Canada for all of your help. We appreciate that very, very much."

"For years in the United States, general aviation was thought of as Piper, and Cessna, and Beechcraft, and Mooney," continued Hinson, and those traditional manufacturers, such as Luscombe, Taylorcraft, and Stinson to name a few before them. In the recent past for a whole host of reasons, the economics of the light airplane field have changed dramatically. Those airplanes that comprise the basic small general aviation population have begun to escalate in value beyond the means of most average Americans who want to fly.

"What we are seeing today and what we saw last year is the beginning of the free market's answer to airplanes that have become economically unaffordable to many Americans. We are, in fact, creating an entirely new, fundamental base of entry level aviation. You are right at the very front of a very new movement."

QUICKSILVER GT-500

The Quicksilver GT-500 is the first U.S. certificated aircraft in the Primary Category. Last year at Oshkosh, the GT-500 was issued the first provisional type certificate under the then new Primary Aircraft Category. This year it received its full type certificate. Production of the certificated GT 500 is expected by the time this article is published.

After accepting the type certificate for his GT 500, Byrum commented on the Primary Category certification standard, "People wondered if the Primary Category was going to be a success. As a result of the Primary Category last year and after our type certification, our orders increased four times. Starting August 15, we are delivering 20 aircraft to the first customer who ordered 100 GT 500's just because of the type certification. It is already a success."

Administrator Hinson inspects the Quicksilver GT 500 with its developer, Lyle Bryrum.

ZENITH CH 2000 and DIAMOND KATANA

The Zenith CH 2000 and the Diamond Katana received their U.S. certification based upon their Canadian type certification. Their certification is a result of the U.S. acceptance of the European Joint Aviation Authorities (JAA) Very Light Aeroplane (VLA) standards as one means of certificating light aircraft in the U.S. The United States accepts the JAA VLA certification standards as providing an equivalent level of safety for certifying the aircraft in the United States. The acceptance of the VLA standards is part of the FAA's ongoing harmonization of U.S. rules with those of other countries.

During the ceremony, Transport Canada representative Ferguson formally recognized the Canadian type approvals of the two Canadian aircraft companies so that they could then be issued their U.S. type certificates.

Administrator Hinson talks with Helge Wittholz about the DA 20 Katana.

Certification officials from both governments acknowledged the amount of work done by the two companies and certification officials from both countries so that the aircraft could receive their type certificates at Oshkosh.

John Colomy, FAA's Small Aircraft Directorate Manager, said, "Daily we are bombarded by all of the negative comments about general aviation. Today we have the opportunity to celebrate a victory, a real victory for the general aviation community." "It has been a real privilege," he added, "to lead and facilitate the FAA's team over the last two to three years. This is a team we can be proud of for their competence and their attitude to get the job done."

To illustrate the cooperation and efforts that went into the certification process by both Canadian and U.S. inspectors, Colomy told a short story about one of the extraordinary efforts done by both the Canadian and U.S. certification teams that enable the Canadian aircraft to be certificated at Oshkosh. He explained that the FAA has to do an acceptance evaluation of an aircraft type certificated by another country in order for the FAA to issue a type certificate based upon the other country's certification. FAA had to do a conformity inspection of the Zenith CH 2000 against its engineering drawings followed by a flight test. The problem was the original aircraft inspected by Transport Canada was not in the U.S.

Colomy said, "In order for us to issue the U.S. type certificate, we had to have the conformity inspection done." There could not be a type certificate issued without the inspection of the CH 2000. The solution to the problem was simple. Transport Canada Inspector John Norris left his wife and child on their vacation and traveled to the United States to do the Canadian portion of the conformity inspection on another aircraft. Assisting in the conformity inspection was FAA inspector Joe Gonsalves from Wichita. Working together, the two inspectors and Mark Anderson, the FAA flight test pilot doing the flight portion of the test, were able to complete the required certification work in time for Oshkosh. This was only one example of the efforts done by both the Canadian and U.S. teams to certificate the aircraft in time for Oshkosh.

Following his acceptance of his type certificates from Transport Canada and the FAA, Chris Heintz, the developer of the CH 2000, compared the revitalization of general aviation to moving a big stone. He said that if everyone cooperates and pushes in the same direction even a big stone can be moved. "Cooperation is what we are after," he said, "The success of these programs have shown it is possible between the regulatory authorities, applicants, and industry to cooperate for the benefit of the citizens of this country and the whole world. In accepting the FAA provisional type certificate for the DA 20 Katana, Helge Wittholz thanked everyone for their extraordinary efforts in certificating the Katana. Because of the uncertainty of certificating the Katana in the U.S. before Oshkosh, he had high praise for the FAA's professionalism and efforts in issuing the provisional type certificate at Oshkosh. He said a year ago there were only 10 Katana people in Canada when they started the certification process, and they hardly even knew how to spell FAA. Since then, they have been able to get the Austrian-designed Katana certified in Canada and the U.S.

Administrator Hinson discusses the Zenith CH 2000 with its developer, Chris Heintz.

New Aircraft Pending Certification

After the ceremony, when asked about other pending new aircraft certification projects, Joe Gonsalves, an FAA Principal Manufacturing Inspector, Manufacturing Inspection District Office, Wichita, KS, said, "We are seeing a lot of interest in certification right now. The manufacturers are in a customer-driven type of operation, and now customers are asking when their particular aircraft is going to be certificated." When asked about the number of aircraft pending Primary Category certification, Joe said, "Speaking only of the Wichita office, we have two that are real close. Both are Rans Aircraft. We have a third aircraft that should be certificated in about a year to 18 months." ■

The Renaissance of General Aviation

Part 2

by Phyllis Anne Duncan, *Editor*

Singer-songwriter Carly Simon wrote and sang eloquently of it—ANTICIPATION. Children awaiting gifts are the epitome of anticipation. Yet, all too often, we build up our anticipation to such a point that when we don't get what we want, the let-down is almost unbearable. For eight years, general aviation anticipated some form of products liability reform, and every year, the let-down when the U.S. Congress didn't pass it led us to predict general aviation's demise.

For longer than the eight years that we have tried to pass products liability legislation, we have watched helplessly but not mutely as production of general aviation aircraft dwindled from an all-time high of nearly 18,000 to an all-time low of just over 500. Much has been written about it; much has been said about it; yet, what was a perennial disappointment for general aviation has just executed a 180. The Congress passed the General Aviation Revitalization Act of 1993, and it was signed by President Bill Clinton on August 17.

After signing the bill, President Clinton said, "An innovative and productive American industry has been pushed to the edge of extinction. This is a job-creating and job-restoring measure that will bring good jobs and economic growth back to this industry.

While the bill had been debated in the House and Senate, several light aircraft manufacturers, who had virtually stopped production for the last decade, said that if there were some form of products liability reform, i.e., a statute of repose, they would begin to build light aircraft again. After President Clinton's signing, Cessna Chairman Russell Meyer said Cessna was evaluating a dozen sites in Kansas to locate a new production facility. Meyer indicated that Cessna would then begin building 2,000 single-engine, piston-powered aircraft. Beech President Arthur Wegner said Beech, too, would immediately begin looking into increasing its production of single-engine airplanes.

The General Aviation Revitalization Act puts an 18-year limitation on product liability for aircraft with a passenger capacity of fewer than 20 passengers. In general, the Act says that, "... no civil action for damages for death or injury to persons or damage to property arising out of an accident involving a general aviation aircraft may be brought against the manufacturer... if the accident occurred (1) after the applicable limitation period...." There are some exceptions, namely when manufacturers have withheld required performance data from the FAA, for persons killed or injured while on a medical transport flight, for persons killed on the ground, and for suits brought under a written warranty enforceable by law.

FAA Administrator David Hinson said that "while this [Act] alone won't turn things around, this is a good law that will help create jobs and revitalize general aviation."

President Clinton signs the General Aviation Revitalization Act into law in the Oval Office. From left to right are Monte Mitchell, Aircraft Electronics Assoc.; Arthur Wegner, Beech Aircraft; Patricia Lehman, Intl. Assoc. of Machinists Sec.-Treas., Dist. Lodge 70 in Wichita, KS; George Hooper, Intl. Assoc. of Machinists Grand Lodge Rep., Dallas, TX; Rep. Dan Glickman (D-KS); Vice Pres. Al Gore; Russell Meyer, Cessna Aircraft; Gov. Gerald Baliles, former Gov. of VA and former head of Nat. Airline Comm.; Sen. Nancy Kassebaum (R-KS); Rep. Jim Hansen (R-UT); Edward Stimpson, GAMA; and Philip Boyer, AOPA.

The possibility of passage of the General Aviation Revitalization Act became more likely last year when the President's national airline commission recommended products liability reform and when both Administrator Hinson and Deputy Administrator Linda Hall Daschle began to work actively for it. Senator Nancy Kassebaum (R-KS) and Congressmen Dan Glickman (D-KS) and Jim Hansen (R-UT) were the principal sponsors of the legislation.

General Aviation Manufacturers Association President Ed Stimpson said of the Act, "The industry will be evaluating other steps toward revitalization.... We must now address other challenges."

Now, in general aviation we should no longer glumly predict our industry's demise; for, according to *Barron's* magazine, we can now anticipate that "it won't be long before American skies start buzzing with something we haven't seen in a while: new, single-engine propeller planes built in the U.S." ■

Ultralight Flying

Associate Administrator Tony Broderick receiving preflight instruction before taking off in the GT-500.

• Wrong Credit

In our September issue the top photo on page 9 was mistakenly credited to Quicksilver. It should have been credited to *Ultralight Flying* magazine. We apologize for the mix up. For more information on the GT-500 and primary aircraft certification, see the article on page 22.

• Comments on Commentary

FAA Aviation News *appears to be becoming a magazine for social commentary and political correctness. This "safety publication" has been moving in this direction for some time.*

John F.X. Brown
Bloomfield Hills, MI

Re "Cockpit Sexual Harassment Follow-Up:" You, along with the female FO, falsely accused an innocent man of sexual harassment, and you don't even have the guts to apologize. The fact that the female FO falsely accused the captain of sexual harassment because "she was tired of receiving criticism of her flying skills" underscores . . . the FACT that females and minorities that are FAR LESS QUALIFIED in terms of actual flying hours (read: experience) than white males are being given hiring preference just to fulfill minority quotas and affirmative-action laws.

David Patterson
San Bernardino, CA

FAA Aviation News instituted commentary as part of a modernization program to make the magazine more competitive with commercial aviation magazines, which have been printing social, political, and enomomic commentary for years. Also, only a miniscule portion of our readership is women aviators, as per our reader survey of a couple of years ago, so we have tried to reach out to them as well. In doing so, we have addressed issues such as sexual harassment in the cockpit, which does occur and has occurred.

In both articles about sexual harassment, we did not print the accused or the accursor's names or the airline for the protection of everyone involved during the course of the adjudication. We have no idea who the captain is, but if he recognized himself in either of the articles, we apologize for the tone of portions of the original article written by Dr. Lamarr O. Stanford.

Falsely accusing anyone of a crime is reprehensible, and we hope that the accuser has been dealt with through the legal system. The captain in this incident was innocent, and we said so in the follow-up article, which a careful reading of it will show. We would like to hear from the captain so we can assure him personally that we had no specific person in mind when the article was printed. He can reach the Editor at (202) 267–8017.

As for airlines hiring women and minorities with less flight time than white males—I don't think so. In my experience, airlines don't hire anybody who doesn't meet their qualification requirements. There's too much at stake if they do. Whether the cockpit holds women, minorities, or white males, we can be assured that they have not only met the experience requirements of the FAR but they also are well-qualified and well-tested to both federal and company standards. Any airlines care to comment?

In the two years we have been doing commentary, these are the first negative comments we have received. We encourage, accept, and implement all constructive criticism of the publication and its contents.

FAA AVIATION NEWS welcomes comments from its readers. We may edit letters for style and/or length. We will select a representative letter from those on the same topic for publication, and because of our publishing schedule, responses may not appear for several issues. We will not print anonymous letters, but we will withhold names or send personal replies upon request. Address: Editor, FAA AVIATION NEWS, AFS–810, Washington, DC 20591. FAX (202) 267–9463.

• Flight vs Ground Visibility

In April 1993, Cyril Toker questioned whether he could land from an instrument approach if he had the "flight" visibility prescribed in the approach regardless of the reported "ground" visibility.

Your lengthy answer quoted the definitions of "flight" and "ground" visibility as well as excerpts from FAR § 91.175. Your amplification remarks were incorrect, and your closing statement implied that a pilot would be held in violation if he landed when the reported visibility was less than that prescribed for the approach even though he had the appropriate "flight" visibility.

The errors in your amplifying remarks were these: You said, "As you can see, no pun intended, flight visibility is the SLANT RANGE (emphasis added) visibility from the cockpit. This is directly contrary to the definition of flight visibility that you quoted which states, "Flight visibility means the average forward HORIZONTAL (emphasis added) distance, from the cockpit . . . . " Then you stated that, "In flight, flight visibility may be greater than ground visibility." This is only partly true. Flight visibility may also be less than ground visibility. All of this in an attempt to justify the flawed interpretation that a pilot operating under FAR Part 91 cannot legally land if he has the flight visibility specified in the approach procedure even if the reported visibility is below the minimum.

Then in the November/December issue of your fine publication, Robert Anderson questioned your conclusions based on a 1981 amendment.

This is but another disagreement with your conclusion based on the following:

***1.** Flight visibility and Ground visibility are based on the same criteria and*

are essentially the same element taken from a different vantage point. The significance of the difference is that the vantage point from a landing aircraft is located at the runway at the exact time of landing rather than a different place and time for the ground observation.

2. *The visibility specified in FAR Part 97 for the approach is stated as "visibility" without specification as to "flight" or "ground."*
3. *FAR § 91.175 is quite clear in stating that a pilot cannot land if the "flight" visibility is below the minimum specified. Which is the same as stating it the other way around—a pilot can land if the "flight" visibility is at or above the minimum specified. If a pilot were not permitted to land when the ground (reported) visibility was below the minimum, regardless of flight visibility, there would be no need to make the statement about the flight visibility. Or the statement would have to read, "No pilot may land when the reported visibility is below the minimum prescribed."*
4. *Finally, full clarification comes in FAR § 135.225. To paraphrase for brevity: A pilot, under Part 135, cannot begin the approach or the final approach segment if the weather is reported below the prescribed minimum. But if the final segment is begun before the weather is reported below the minimum, the pilot may continue the approach and land "if the pilot finds, upon reaching the authorized MDA or DH, that actual weather conditions are at least equal to the minimums prescribed for the procedure."*

Now I ask you. If the regulations allow a pilot carrying passengers for hire to land when he has flight visibility equal to or greater than prescribed even when the reported visibility is below that prescribed, how can the regs deny a pilot under Part 91 the same privilege?

Robert V. Williamson
Prof. of Aviation
Florida Community College at Jacksonville

• When is an Approach not an Approach?

I am totally confused and need your help. For the sake of legalities in IFR currency—

a) What constitutes an "approach?" Does the descent have to be made from full-time in the soup down to minimums? If minimums are not available, is breaking out at 1,200 ft for a 290-ft DH (crude numbers, only to make the point) count as an approach? Does 1,500 ft still count? How high do the tops have to be? Do they have to be above the FAF? Does shooting through a 1,000 ft layer of coastal fog make half an approach, of which one has to make 12 to count for the six required approaches?

b) What constitutes flying in IMC? Is flying between solid layers from cloud bank to cloud bank legally IMC? Is flying in a layer of broken ceiling IMC? Do people fly with the stopwatch in their hand (a third hand, perhaps) to time and subtract every 30 seconds of time when they can see past the cowling from their legal IMC time—as one of my instructors books time? Trouble is, he looks out to the right side where he sees ground sometime, and I look out to the left side where I don't see ground, so our time keeping disagrees quite a bit.

Please help!

Louis Temesvary
Palo Alto, CA

They don't. A pilot operating under FAR Part 91 can land if flight visibility is equal to or greater than the visibility prescribed in the standard instrument approach procedure being used. FAR § 91.175(d), *Takeoff and landing under IFR*, applies.

If your instrument instructor doesn't know or won't pass along the answers to these questions to you, fire him and hire someone who will.

FAR § 61.57 states that no pilot can act as PIC under instrument flight rules (IFR) or in less than VFR minimums unless within the preceding six months, the pilot has logged six hours of instrument time (three hours in flight and in the category of aircraft involved) and accomplished six instrument approaches, or unless the pilot has accomplished an instrument proficiency check in the category of aircraft involved.

FAR Part 1 doesn't define "approach," but the *Airman's Information Manual* (Glossary I–2) does:

"A series of predetermined maneuvers for the orderly transfer of an aircraft under instrument flight conditions from the beginning of the initial approach to a landing or to a point from which a landing may be made visually."

FAA believes it is reasonable to expect that, for currency purposes, a pilot fly a *significant portion* [emphasis added] of the elements which constitute an approach. This is to assure that the pilot gains the benefit of configuring the airplane to comply with the published parameters for heading, altitude, speed, timing, and descent rate required for the approach.

The AIM defines IMC as "meteorological conditions . . . less than the minima specified for visual meteorological conditions." VFR minimums are found in FAR § 91.155.

FAR § 61.51(c)(4) states that "A pilot may log as instrument flight time only that time during which he operates the aircraft solely by reference to instruments, *under actual or simulated instrument flight conditions*."

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Airworthiness Notes

Electronic Signatures and FAR § 43.9

A signature is the name of a person as written by him or herself. Therefore, air agencies that elect to use electronic signatures need to apply for an exemption from the requirements of FAR § 43.9. The FAA has acknowledged that computer technology has vastly changed since the draft of FAR § 43.9, and so the electronic signature issue is currently being addressed within the Aviation Regulatory Advisory Committee for Aircraft Records. In the meantime, FAA will consider each exemption for electronic signature on a case-by-case basis. For additional information contact Howard Vaughn at (703) 661–0333, ext. 5009.

Voluntary Self-Disclosure

The voluntary self-disclosure program has been in effect for FAR Part 121 and 135 certificate holders since 1990. With the experience FAA has gained, we are expanding its use to FAR Part 145 certificate holders. Guidance for the program can be found in the following documents:

- AC 120–56, Air Carrier Voluntary Reporting Procedures
- AC 120–59, Air Carrier Internal Evaluation Programs
- FSAW 93–56, Changes in the Self Disclosure and Remedial Training Programs
- Action Notice 8430.65, Air Carrier Internal Evaluation Program
- Compliance/Enforcement Bulletin No. 90–6
- Notice N 8000.277, Air Carrier Internal Evaluation and Voluntary Disclosure Program

An AC for repair stations is being developed and will be completed this year. Questions about this program should be directed to Glen Kinney of the FAA's Repair Station Branch at (202) 267–3781.

EAA Announces Flight Advisor Program

The Experimental Aircraft Association (EAA) has announced a major new program designed to help pilots safely transition into unfamiliar aircraft and conduct first flights on just-restored or constructed airplanes.

The EAA Flight Advisor program is a volunteer corps of EAA members who have flight experience in specific types of aircraft and are willing to share that knowledge with others.

"The Flight Advisors use their own experience to help other sport pilots evaluate their own ability to fly a given aircraft," said EAA President Tom Poberezny. "The Advisor also serves as a guide and resource to help ensure appropriate skill is present or can be developed by the pilot."

The Flight Advisor's primary role will be to work with pilots and builders who are about to fly a new aircraft for the first time. The program's premise is that a less experienced pilot can benefit from the advisor's experience in that particular airplane type. Advisors will specialize in specific types of aircraft, such as homebuilts, ultralights, vintage airplanes, and contemporaries.

The Flight Advisor is not a test pilot or instructor and will not do any actual flying. The advisor will help the pilot/builder determine if that person's skills are adequate to fly the airplane safely. The pilot/builder will then make the final flight decisions following the evaluation. If the pilots decide their skills are adequate, Flight Advisors will help coordinate and plan the first flight. Advisors may also provide assistance via radio during the flights if requested. If more training is needed, Flight Advisors will work with each pilot to determine the type of instruction required and help locate a source for instruction.

For more information on the EAA Flight Advisors Program, call (404) 426–4800 or 1–800–843–3612.

Flight Standards' Focus on Customers

by Sandy McRae, *FAA's Flight Standards Service, Strategic Management Branch*

Vice President Al Gore's National Performance Review, outlined in the document commonly referred to as "Reinventing Government, has a goal of "Putting Customers First." Under that goal government agencies providing services must periodically survey its customers on how well they do their jobs. FAA's Flight Standards Service got a start on surveying its customers before Vice President Gore was elected.—Editor

The Flight Standards Service has a survey program in place that puts customers first. In the summer of 1992 the Flight Standards Customer Survey Program was created to assess customer satisfaction with service, to establish a baseline of quality service, and to focus Flight Standards managers on areas they need to address in order to meet and exceed customer expectations—*on a continual basis*.

The survey is sent to a representative sample of customers within a Flight Standards District Office's (FSDO) jurisdiction. The sample includes pilots, aircraft owners, pilot and written test examiners, and certificate holders. If you fall into one of those categories, you just might get a survey in the mail!

The simplicity of the process has been its principal selling point. The survey is designed in two stages. First, a questionnaire is sent to customers, asking them to indicate which of the services Flight Standards provides are most useful to them. Then, a second questionnaire is sent, asking customers how satisfied they are with the quality of service provided in the areas identified as important to them. The second questionnaire also asks what Flight Standards can do to improve service quality. Both questionnaires are 3X5-inch fold-over cards and take only three to seven minutes to complete. The results are compiled and provided to the Flight Standards managers, who use the result to make resource allocation decisions that are more in line with customer needs and expectations.

Mr. Thomas C. Accardi, Director of the Flight Standards Service, says the customer survey program "asks customers what they want, what problems they have, and how to improve service. And the best part is, we are pay-

ing attention to what our customers are saying."

But don't take our word for it. No less an authority than Mr. Robert Stone, the Project Director of the National Performance Review, complimented Flight Standards' focus on customer service when he spoke before a recent strategic planning conference for Flight Standards' managers.

For information on the Flight Standards Customer Survey Program, contact its Program Manager, Mr. John Hancock at (916) 551–1721; fax (916) 551–1741.

Computer Based Written Test Program

The FAA has converted from the time-honored pencil and paper airman knowledge tests to a computerized means for conducting the written tests that are fundamental to acquiring most airman certificates.

In November 1989 FAA initiated a national computer-based airmen knowledge testing program designed to enhance security, improve statistical data, and substantially lower administrative costs over the pencil and paper test system. Cost savings to the FAA amount to approximately $1.4 million a year.

Computer-based airmen knowledge testing provides a more efficient and progressive educational evaluation process compared to the pencil and paper testing method. The computer-based testing provides for timely updating and validation of tests. The program provides both immediate test results to the applicant and required remedial information to the airman's instruction and examiner.

The conversion to the computer-based airmen knowledge testing program will be complete with the withdrawal of all paper tests—question selection sheets, answer sheets, and written test books.

During the conversion process, a study guide will be published explaining the procedure for the conduct of a computer-based test. The study guide will contain a list of pertinent study materials, subject matter knowledge codes, and sample test items which are representative of questions in the test. The study guide will serve as the FAA knowledge standards for that certification and rating area.

When a test area is converted to computer-based testing, the associated FAA written test book will no longer be published. The FAA will provide questions and their associated subject matter reference material through an electronic bulletin board service.

The conversion to total computer-based testing involves the following schedule:

As of December 1, 1993
- Recreational Pilot-Airplane
- Recreational Pilot-Gyroplane
- Recreational Pilot-Helicopter
- Private Pilot-Balloon-Gas
- Private Pilot-Glider
- Private Pilot-Lighter than Air-Airship
- Private Pilot-Gyroplane
- Commercial Pilot-Balloon-Gas
- Commercial Pilot-Glider
- Commercial Pilot-Gyroplane

As of March 15, 1994
- Flight Instructor-Gyroplane
- Flight Instructor-Gyroplane Added Rating
- Flight Engineer-Reciprocating/Basic
- Flight Engineer-Reciprocating Added Rating
- Instrument Rating-Helicopter
- Instrument Rating-Helicopter Added Rating
- Instrument Flight Instructor-Rotorcraft/Helicopter
- Instrument Flight Instructor-Rotorcraft/Helicopter Added Rating

As of July 15, 1994
- Commercial Pilot-Rotorcraft/Helicopter
- Commercial Pilot-Lighter than Air-Airship
- Private Pilot-Rotorcraft/Helicopter
- Airline Transport Pilot-Airplane (FAR 135)
- Flight Engineer-Turboprop/Basic
- Flight Engineer-Turboprop Added Rating
- Flight Engineer-Turbojet/Basic
- Flight Engineer-Turbojet Added Rating
- Pilot Examiner-Airplane
- Pilot Examiner Bailoon
- Pilot Examiner-Glider
- Pilot Examiner-Rotorcraft

As of September 15, 1994
- Commercial Pilot-Airplane
- Commercial Pilot-Free Balloon-Hot Air
- Military Competence-Airplane
- Military Competence-Helicopter
- Instrument Flight Instructor-Airplane
- Instrument Flight Instructor-Airplane Added Rating
- Ground Instructor-Instrument
- Private Pilot-Free Balloon-Hot Air
- Fundamentals of Instructing
- Aircraft Dispatcher

Scheduled for December 15, 1994
- Instrument Rating-Airplane
- Instrument Rating-Airplane Added Rating
- Instrument Rating-Foreign Pilot
- Airline Transport Pilot-Airplane Added Rating
- Airline Transport Pilot-Rotorcraft/Helicopter
- Airline Transport Pilot-Rotorcraft/Helicopter Added Rating
- Ground Instructor-Basic
- Ground Instructor-Advanced

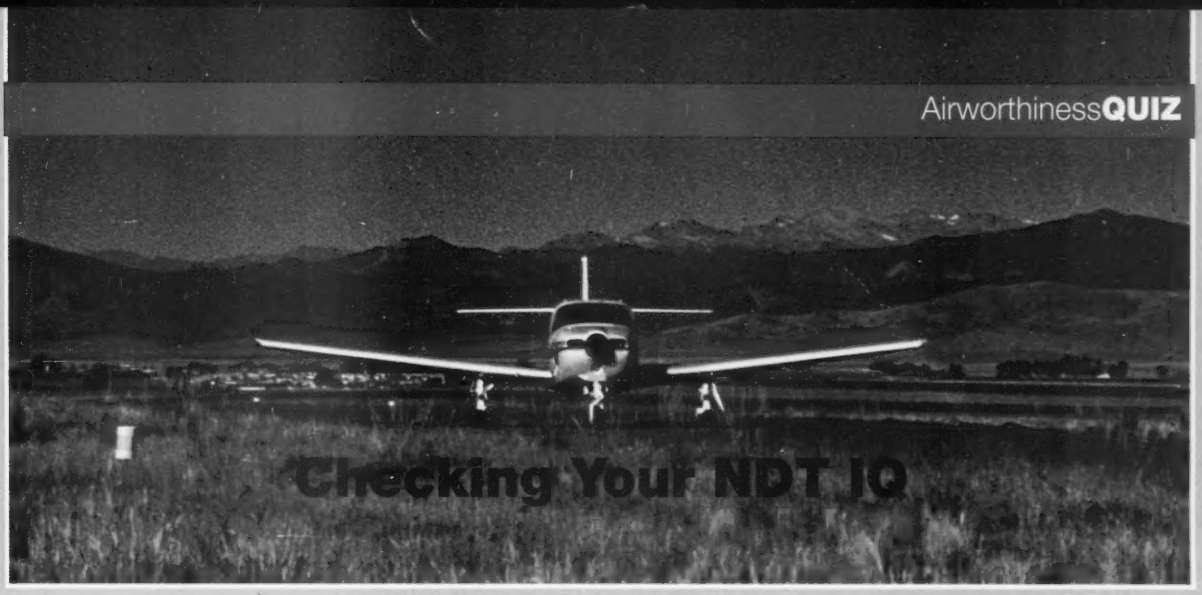
Scheduled for March 15, 1995
- Flight Instructor-Airplane
- Flight Instructor-Glider
- Flight Instructor-Rotorcraft/Helicopter
- Flight Instructor-Airplane Added Rating
- Flight Instructor-Glider Added Rating
- Flight Instructor-Rotorcraft/Helicopter Added Rating
- Airline Transport Pilot-Airplane FAR 121
- Parachute Rigger-Senior
- Parachute Rigger-Master
- Parachute Rigger-Military Competence

Scheduled for June 15, 1995
- Private Pilot-Airplane
- Aviation Mechanic-General
- Aviation Mechanic-Powerplant
- Aviation Mechanic-Airframe
- Private Pilot-Airplane/Recreational Pilot Transition
- Private Pilot-Gyroplane/Recreational Pilot Transition
- Private Pilot-Helicopter/Recreational Pilot Transition

Applicants can contact their local FSDO's for a list of computer test designees, or contact the following computer testing centers:

- **Aviation Business Services,** 1–800–947–4228; (415) 259–8550 outside the U.S.
- **Drake Training And Technologies, Inc.,** 1–800–359–3278; (612) 896–7702 outside the U.S.
- **Sylvan Learning Systems, Inc.,** 1–800–967–1100; (410) 880–0880 outside the U.S.

This article is based on FAA Advisory Circular 60–23, "Conversion to the Computer-Based Airmen Knowledge Testing Program," issued June 17 of this year. Copies are free from U.S. DOT, General Services Section, M-443.2, Washington, DC 20590.



Checking Your NDT IQ

by Bert Labbe

There are five basic inspection methods for NDT (non-destructive testing): Liquid penetrant, Magnetic particle, Eddy current, Ultrasonic testing, and Radiography. The subject matter [of this quiz] will be dealing with the Liquid Penetrant Inspection Method.

The purpose behind the following self test is to help inspectors and/or maintenance personnel evaluate their current qualifications and equipment. The answers are on page 13.

TRUE OR FALSE (Circle One)

1. **T or F:** Liquid penetrant inspection is a method of detecting and indicating surface discontinuities in relatively non-porous materials.
2. **T or F:** Liquid penetrant inspection is the best method for finding discontinuities exposed to surfaces of non-magnetic materials.
3. **T or F:** Pre-cleaning or surface preparation should be considered the most important step in liquid penetrant inspection.
4. **T or F:** The two liquid penetrant systems, also referred to as Type I and Type II, can be used interchangeably.
5. **T or F:** The time between developer application and inspector interpretation is important.
6. **T or F:** The intensity level for a black light is important.
7. **T or F:** Eye exams including color perception is important.
8. **T or F:** Fluorescent penetrants generally show a red (pink) indication on a light background.
9. **T or F:** Fluorescent penetrant results are best observed in an area illuminated by a bright visible light source.
10. **T or F:** When acid cleaning is used prior to fluorescent penetrant inspection, residual acid may reduce the fluorescence of the penetrant.
11. **T or F:** Alodine and anodized surfaces tend to hold penetrant.

MULTIPLE CHOICE (Circle one)

12. Two major types of liquid penetrant inspection exist.
    - **A.** Zyglo and dye penetrant
    - **B.** Magnaflux and dye penetrant
    - **C.** Visible and fluorescent dye penetrant
13. Penetrant dwell time is in reference to:
    - **A.** The time it takes to perform the inspection.
    - **B.** The time required to obtain optimum penetration of penetrant.
    - **C.** The time required to allow the developer to draw the penetrant out of the discontinuities.
14. Surface conditions which tend to interfere with successful penetrant inspection include:
    - **A.** Shot peening
    - **B.** Grease
    - **C.** Paint
    - **D.** Heavy sand blasting
15. The following liquid penetrant inspection method must be performed in subdued light (preferably in a darkened area):
    - **A.** Dye penetrant using a black light
    - **B.** Fluorescent dye using a black light
    - **C.** Both **A** and **B**

Mr. Labbe is an airworthiness inspector in the FAA's Windsor Locks, CT, Flight Standards District Office. This quiz originally appeared in the January—March 1994 issue of Airwaves, *a safety newsletter published by the Windsor Locks FSDO.*

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